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The Electrical Engineer.

Vol. XXVII. JANUARY 5, 1899. No. 557.

THE HISTORY AND GROWTH OF THE PEOPLES LIGHT AND POWER COMPANY OF NEW JERSEY.

BY MAX LOEWENTHAL.

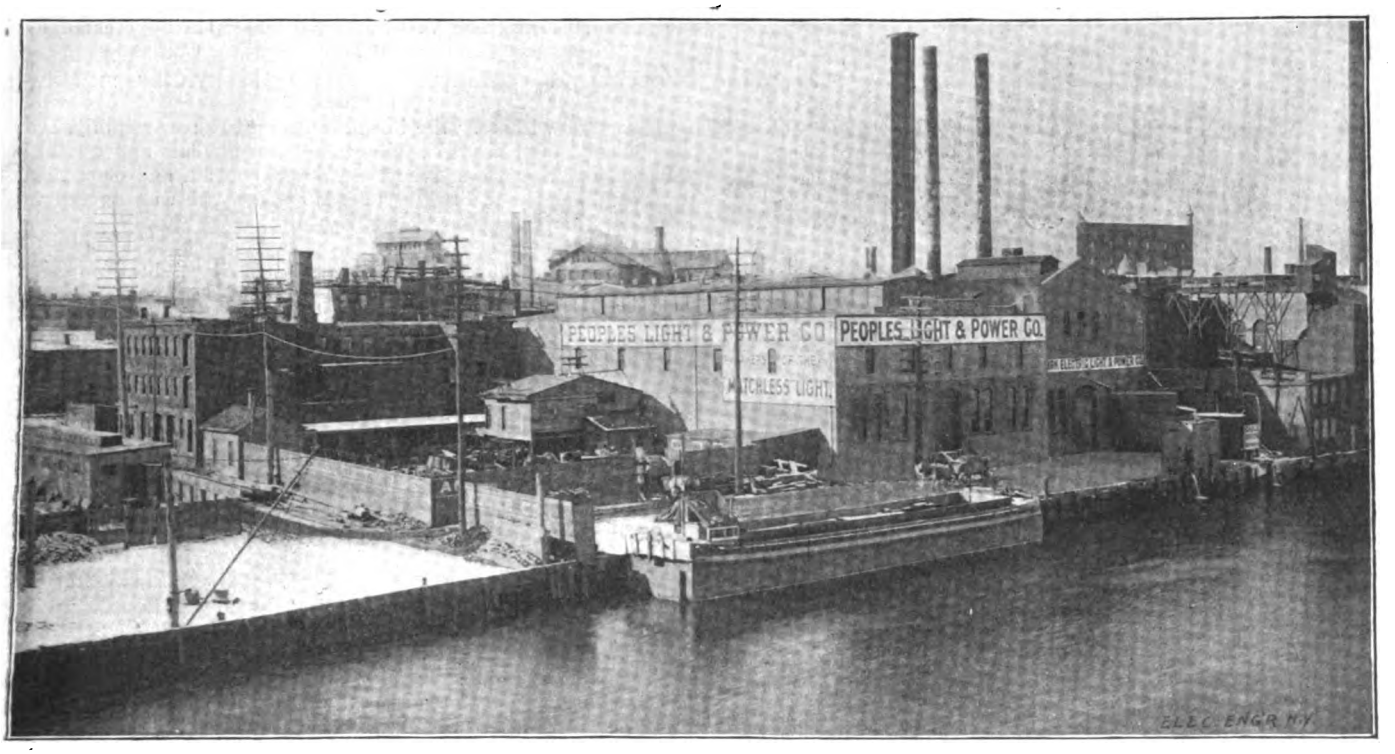
THE organization and expansion of the Peoples Light and Power Company, of New Jersey, form one of the most interesting and creditable chapters in the history of electric current supply in the United States, and are strictly characteristic of American foresight and energy, as well as central station practice and engineering tendencies. Since its formation, a broad-minded and liberal policy has been observed by the management of the company, which explains its wonderful and rapid expansion and absorption of every competitive company, and its phenomenal success in obtaining municipal contracts.

The company has demonstrated beyond a doubt that it is feasible and advisable to furnish current from a single central station to a large number of municipalities. It is a vivid object lesson to municipal authorities and the supporters of "municipal ownership of everything," who believe in overburdening the citizens with taxes and bond issues rather than purchasing current from private companies who have the facilities, experience and ability and dare not shirk their responsibility for fear of competition. It has always been the aim of this company to furnish to its customers the most efficient service and modern apparatus, and to reduce its rates whenever the amount of current sold and other conditions warranted such a course. Perhaps the most striking feature in the company's history is the extreme vigilance and tact employed by them at all times, which has brought about the remarkable result that in the entire territory which they supply, covering two entire counties with a population of about 600,000, there are in existence to-day less than one dozen isolated plants. This may well be pointed out as a non plus ultra of sagacious business management of a central station enterprise, and represents a condition which makes one reflect and speculate as to the future of electric current supply.

HISTORICAL.

The Peoples Light and Power Company, a corporation of the State of New Jersey, having its principal office in the city of Newark, was organized in 1894 by the same people who were in charge of and who have, for a number of years, operated the Newark Electric Light and Power Company. This company has been actively engaged in the business of furnishing electric light and power since its organization, February 21, 1882. While the Peoples Light and Power Company has only been supplying electric current in its own name and by right of its own franchises since April 1, 1896, it has had the benefit of the business, the location, and the experience of the several companies it now owns and operates, and which have been in operation different lengths of time, ranging anywhere from two to sixteen years.

A comprehensive history of the organization, formation and expansion of the Peoples Light and Power Company up to the present time will therefore necessarily include a number of matters and transactions which have been initiated, and in some cases completed by one of the several companies now included in the organization.



NEW RIVER STATION OF THE PEOPLES LIGHT AND POWER CO., NEWARK, N. J.

The Newark Electric Light and Power Company, organized in 1882 as stated above, began business as the licensed agent of the United States Electric Light Company, manufacturers of arc and incandesent apparatus under the Weston system.

The company began business first by running a few machines in the United States factory. Afterward power was leased in the engine building shop of the Hewes & Phillips Iron Works, from which place the business of the company, consisting of a

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few arc lights, was conducted until the completion of the first station located at 31-33 Mechanic street some time in the winter of 1882-3.

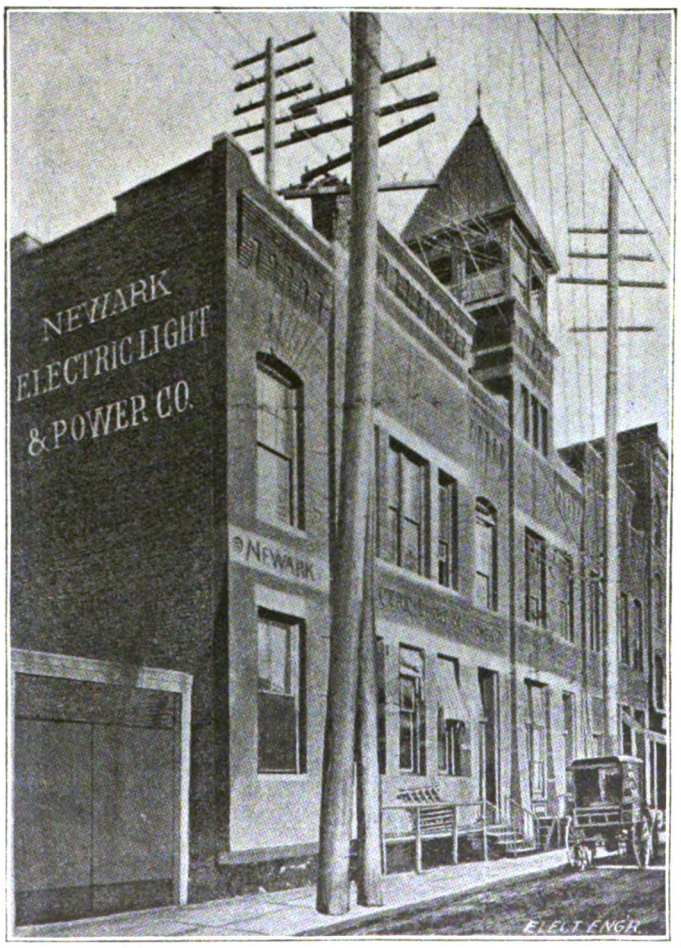
MECHANIC STREET SUB-STATION.

The first installation in this station, and which in fact is still in use pending the completion of the large new station on the river, and described in the sequel, consisted of one Watts-Campbell Corliss engine of 400 horse power and four horizontal tubular boilers. The dynamos at that time were all for arc lighting and consisted of a miscellaneous lot of machines which had been acquired from the time of organization of the company to that date, and ranged in capacity from 2 to 10 lights each. An order was then placed with the United States Company for one of their shunt wound 20 light arc machines, which type was brought out soon after the completion of this station.

In 1886, the first incandescent lights were turned on from the station; the dynamo installed being a 125 light, 70 volt, United States type. The first lights were operated in the house of the Essex Club on Park place, an organization of which Mr. Edward Weston was a member at the time.

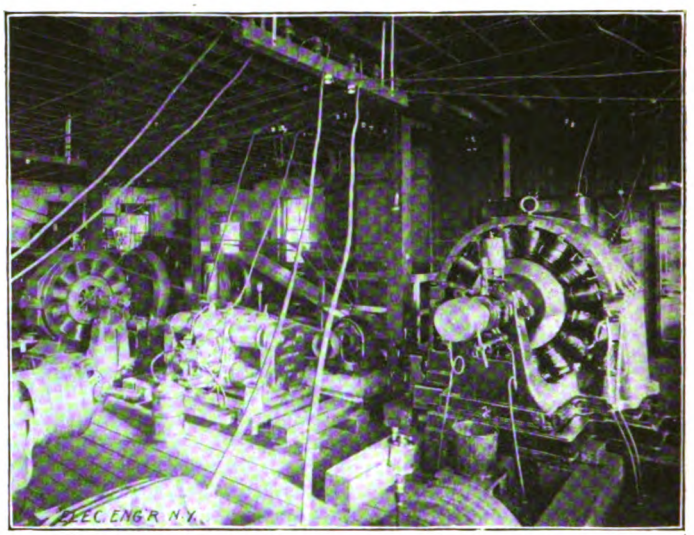
During this year, also, the company acquired additional property adjoining Mechanic street station of somewhat more than double its size at that time. The building was enlarged and improved and new apparatus started in the winter of 1886-7. At this time also, the company began operating, for the first time, day service for incandescent lighting. The engine used for this purpose was a New York Safety Steam Power Company's engine of about 30 horse power capacity, which was sufficient to run the day load during the year 1887.

However, this equipment was soon found inadequate to meet



MECHANIC STREET SUB-STATION, NEWARK, N. J.

the growing demand for current, and additional machines were installed, so that to-day the station has a capacity of 13,000 incandesent lamps and furnishes current for 150 horse power in motors. It has a battery of thirteen boilers, of the Hewes & Phillips, Phoenix Iron Works and L. J. Lyons makes, having an aggregate capacity of 1,300 horse power and operated at a pressure of 100 pounds. Water is obtained from the city main and pumped by Knowles and Smith-Vaile pumps through heaters of the Webster and Berryman types. There are two Watts-Campbell high pressure engines of 250 and 350 nominal horse power, and three Hewes & Phillips high pressure engines,



INTERIOR OF "GRAVEYARD" SUB-STATION, NEWARK, N. J.

two of which are 200 and one of 250 nominal horse power. All of these engines are of the Corliss type. There is now in course of construction one 300 k. w. 220 volt rotary transformer, the secondaries of which are to be connected on the three-wire system. This machine was furnished and is being erected by the Westinghouse Electric and Manufacturing Company.

OVERCOMING COMPETITION—THE "GRAVEYARD" SUB-STATION.

Beginning with 1887 the business began to grow steadily, but very slowly. All kinds of inducements, arguments and guarantees had to be made to secure a customer at all, and even then it was considered the height of luxury by those who agreed to take the service.

During 1886, two rival companies were started in Newark, the first being the Newark Schuyler Electric Light Company, which was started as an off-shoot of the Waterhouse Electric Manufacturing Company, afterwards merged into the Schuyler Company; the other being the Thomson-Houston Electric Company, which was started as a sub-company to the parent concern manufacturing Thomson-Houston dynamos. Both of these companies operated arc lights only, and started in immediately to secure business at any price. Competition raged fiercely and at one time prices were reduced to such an extent that arc lights were taken at $1.50 per month on yearly contracts, a rate which has never since been equalled under any conditions of power in the memory of the oldest person in the electric lighting business. Such prices as were paid during a period of over six months being ruinously low forced both of the smaller companies out of business, and they were subsequently bought in by the Newark Company; the Schuyler being taken in in September, 1889, and the Thomson-Houston in June, 1890.

Shortly before the acquisition of these two companies, the Central Power Company was organized in the city of Newark for the purpose of supplying power for manufacturing purposes only. This company was started by a person interested in the Daft Electric Company, which acquired a business of some 200 horse power, and was sold out under foreclosure with the old Daft Company, which owned a majority of the business, some time in 1893. The assets of the local company were bought by a few gentlemen in Newark and operated independently until the close of the year 1896, at which time they concluded to give up the business and they sold their plant and apparatus to the Peoples Light and Power Company.

This station, which is unique in having within an area of about 100 square feet four different types of machines, none of which is being built at the present time, is still operated by the company as a sub-station, and being located near a graveyard has been called the "graveyard" station. It will itself be buried upon the completion of the new River station.

It now has a capacity of 300 horse power in boilers furnished

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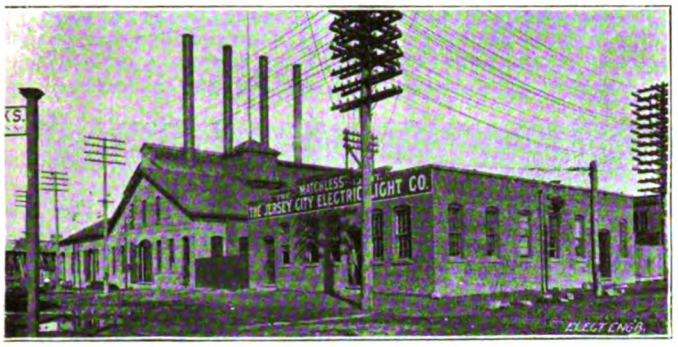
by the Phoenix Iron Works, one pair of Hewes & Phillips simple engines of 250 horse power, which are belted to one 200 kilowatt 1,000 volt Westinghouse alternator, one 125 light Wood arc machine and one 50 k. w. 110 volt direct current Westinghouse generator. The Daft machines which are still in place are not being operated at present.

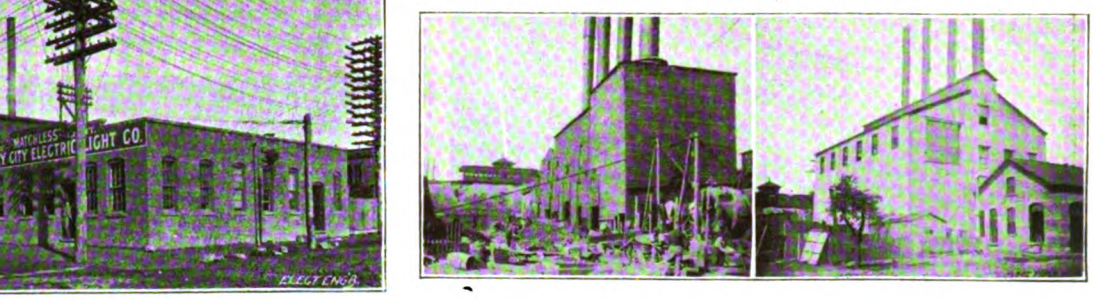


THE GENERATING STATION AT JERSEY CITY, N. J.

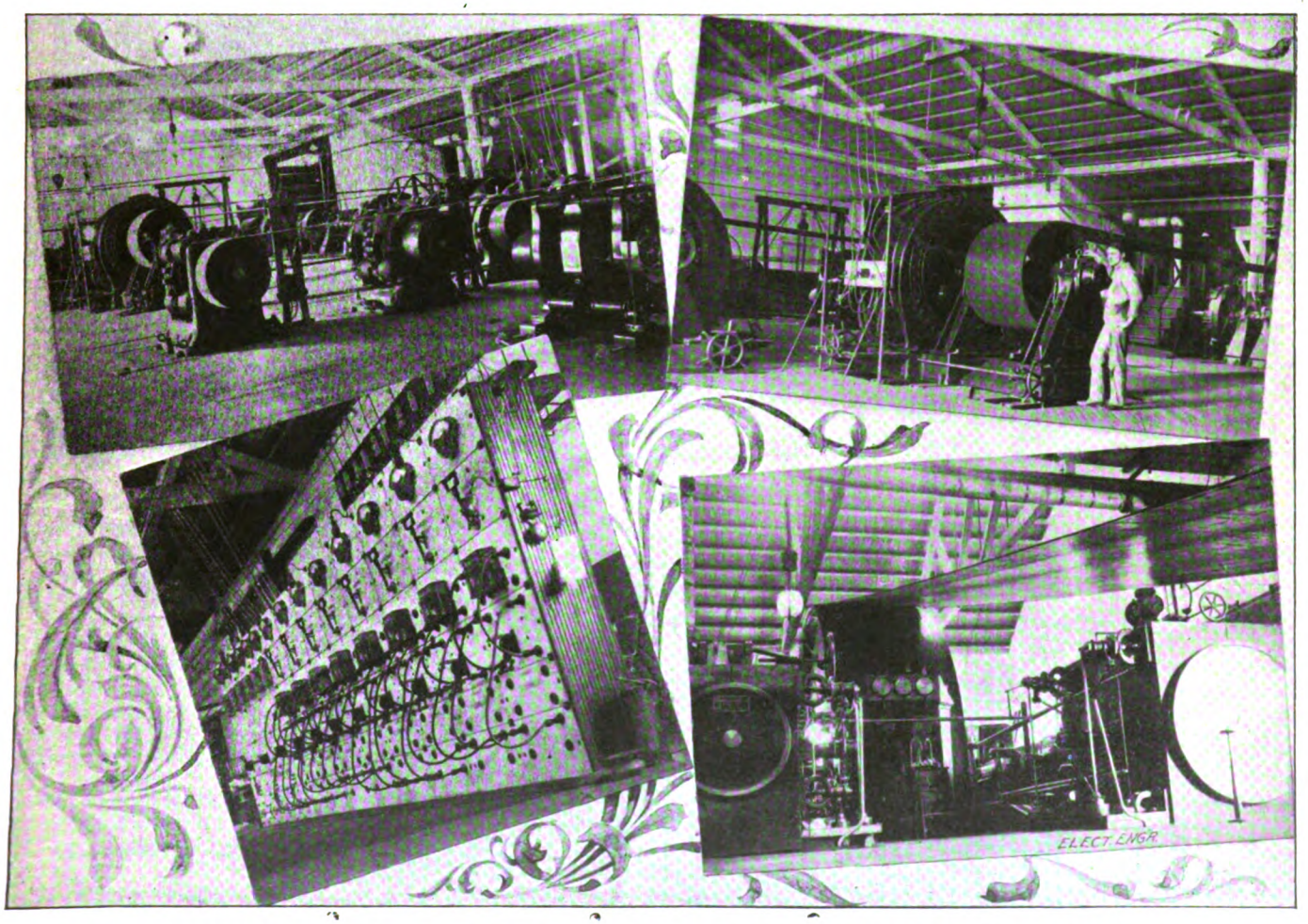
BIRTH OF THE PEOPLES LIGHT AND POWER COMPANY.

The Peoples Light and Power Company, as stated above, while organized in 1894, did not begin operations of any kind until the early summer of 1895. At that time a majority interest in the Newark Electric Light and Power Company, having been previously acquired by New York capitalists, was offered for sale. The management of the Peoples Light and Power Company learning of this fact acquired the said control of the Newark Electric Light and Power Company, and immediately began its reorganization.

In the fall of 1895 the Peoples Company was requested to bid on the public lighting of Jersey City, which at that time had but 163 arc lights on its streets, operated in about equal proportions by the Jersey City Electric Light Company and the Hudson County Electric Company, two corporations which at that time were doing a small amount of business in Jersey City and Bayonne. The Peoples Company, being the lowest bidder in the central section or the business portion of Jersey City, acquired the lighting, which had been done up to that time by the two companies last named, and forced the said two companies to build a large amount of new line on the outskirts of the city, in order to carry out the lighting of the other districts, which they had acquired under their bids; it having been previously determined by the officials of Jersey City to extend the electric street lighting to a very large extent. Being placed in that position, the Jersey City Electric Light Company and the Hudson County Electric Company each made overtures to the Peoples Company to take their property off their hands, which had been rendered practically valueless by reason of their losing



THE JERSEY CITY BOILER HOUSE, BEFORE AND AFTER ALTERATIONS BY THE PEOPLES LIGHT AND POWER CO.



INTERIOR VIEWS OF THE PEOPLES LIGHT AND POWER COMPANY'S PLANT AT JERSEY CITY, N. J.

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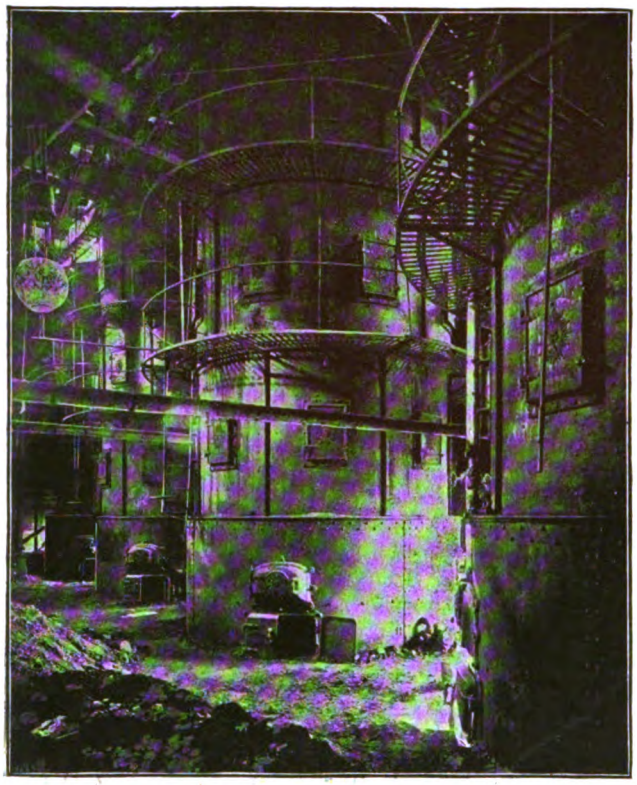
the contract for lighting where their lines already existed. Negotiations were opened and terminated in the purchase of these companies of the Peoples Company.

THE JERSEY CITY STATION.

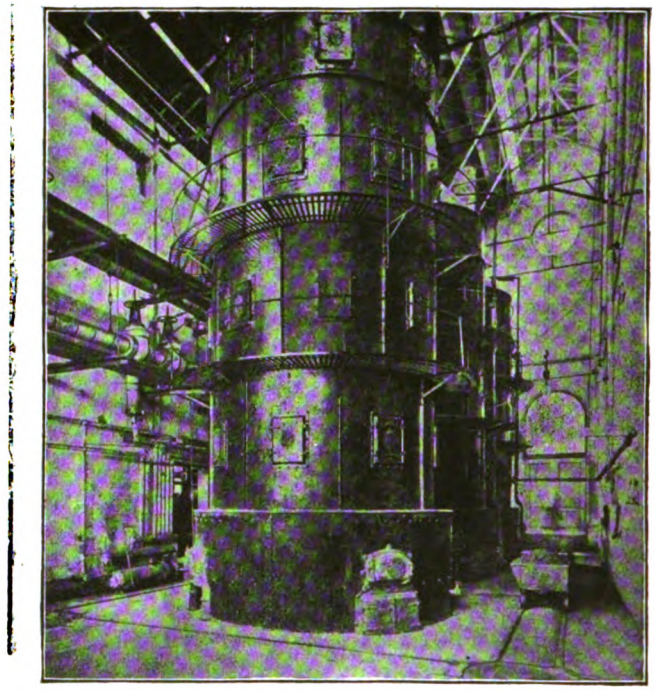
The Jersey City station is situated on the corner of Wayne and Fremont streets, near the Pennsylvania Railroad, and occupies a space of 132x190 feet. A new boiler house has just been completed and is constructed of steel and corrugated iron. At one side is located the coal pocket, having a capacity of about 1,100 tons. Above this pocket is run the track which is to connect with the new steel bridge, now in course of construction, furnished by the Passaic Rolling Mill Company, which is to run from the boiler house to the railroad, and upon which it is proposed to bring in the coal.

The steel for the boiler house was furnished by the Berlin Iron Bridge Company, and was erected by the Sandford and Stillman Company, contractors.

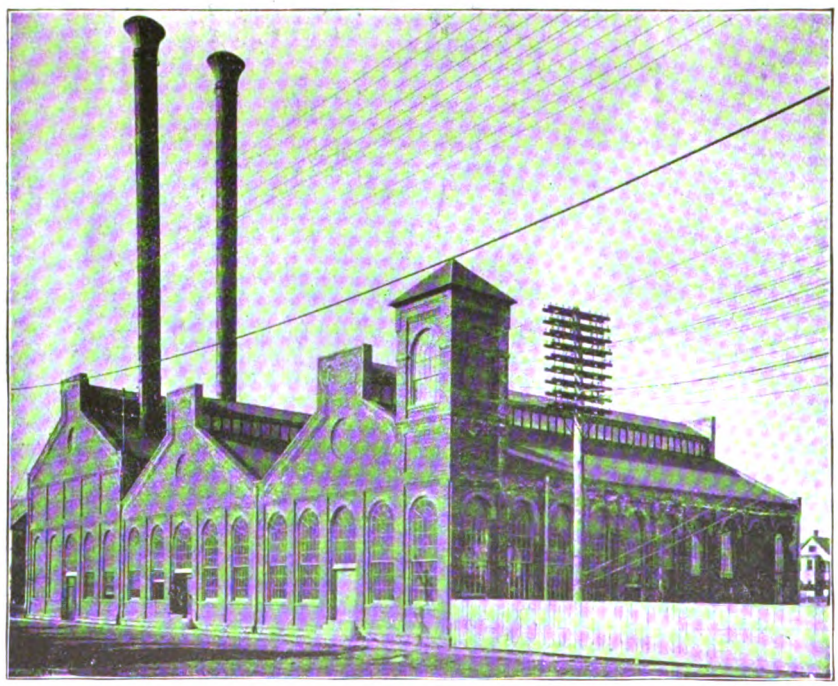
The floor of the boiler house is concreted and has tracks furnished by the Link-Belt Engineering Company, upon which are run the several charging cars that are used to feed coal to the boilers. These cars receive their supply from the coal pocket which has numerous gates through which the coal is deposited into the cars.



BOILER ROOM IN JERSEY CITY STATION, CONTAINING FOUR 600 H. P. MORRIN "CLIMAX" BOILERS.



BOILER ROOM AT ORANGE, N. J., CONTAINING THREE 600 H. P. MORRIN "CLIMAX" BOILERS.



STATION OF THE PEOPLES LIGHT AND POWER CO., ORANGE, N. J.

In this boiler house are located four 600 horse power "Morrin" Climax boilers, which carry a steam pressure of 140 pounds each.

The engine room contains one Watts-Campbell 26x50x60

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cross-compound condnsing engine which, together with a George H. Corliss 26x50x48 cross-compound engine, is belted to a long shaft, from which are run the numerous generators.

These engines are run at a speed of 70 and 90 revolutions per minute respectively.

There are belted to the main shaft twelve 125 light Brush arc machines, six Wood arc machines, two Thomson-Houston arc machines, two 240 kilowatt two-phase, 2,000 volt Stanley alternators and one 250 kilowatt 500 volt direct current Westinghouse power generator.

There is also one McIntosh & Seymour 18x32x19 tandem compound engine which is belted to a 150 kilowatt 500 volt direct current Westinghouse power generator and a 150 kilowatt two-phase Stanley alternator generating a pressure of 2,000 volts.

The McIntosh & Seymour engine, together with the Watts-Campbell engine, is exhausted into a Wheeler horizontal surface condenser, the McIntosh & Seymour engine being operated on the day load and the Watts-Campbell on the night. The George H. Corliss engine is condensed by means of a Worthington horizontal jet condenser.

Water for these condensers is obtained from two dug wells 15 feet in diameter by about 30 feet deep.

Feed water is obtained from the city main and is pumped by Knowles and Smith-Vaile pumps from a Cochrane open feed water heater to which are run the exhausts from the several pumps and condensers, and an American feed water heater is now being installed between the George H. Corliss engine and its condenser.

Current is supplied by this station to 10,000 incandescent lights, 1,700 arcs and 350 k. w. in motors.

ACQUISITION OF FURTHER PROPERTY—THE ORANGE STATION.

A similar method to that in which the Jersey City and Hudson County plants were acquired was followed in the case of Harrison, and in like manner the plant and property of the Excelsior Electric Co. was acquired, the Peoples Co. having secured the contract by reason of a lower bid. In Orange the plant and property of the Essex County Electric Company and in East Orange the plant and property of the Suburban Electric Light and Power Company were voluntarily offered to the Peoples Company, and negotiations resulted in their purchase.

The Orange station is situated on Lakeside avenue, between High and Cleveland streets, with a siding connected to the Erie railroad, which runs into the boiler house, the side of which contains the coal pocket of a capacity of 600 tons. Under this pocket are located the several tracks of the Link-Belt Engineering Company, which tracks extend from under the coal pocket to the boilers.

There are three 600 horse power "Morrin" Climax boilers run at a steam pressure of 120 pounds.

In the engine room are located two Watts-Campbell cross-compound Corliss engines of 1,000 and 650 horse power respectively, which are belted to a line shaft from which are run six 125 light Brush arc machines, two 240 k. w. two-phase Stanley alternators, which supply current for the incandescent lighting, one 300 k. w. Westinghouse direct current 500 volt generator, and two 100 k. w. General Electric 500 volt power generators.

The pumps for this station were furnished by Henry R. Worthington and the condenser is of the Wheeler horizontal surface type. The feed water is heated by a Cochrane open heater.

INTERIOR OF STATION OF THE PEOPLES LIGHT AND POWER CO., AT ORANGE, N. J.

IN COMPETITION WITH GAS COMPANIES.

Other plants were acquired from time to time, as follows: In 1896, the Montclair Light and Power Company, Consumers Electric Light and Power Company, Edison Electric Light and Power Company; and in 1898, the Kearney Electric Light and Power Company.

In 1897, the Peoples Company bid on lighting the town of Irvington in competition with the Newark Gas Company. The refusal of the gas company to extend its mains for private consumers, except in the event of their securing the municipal contract, necessitated an offer on the part of the Peoples Company to supply gas to such residents as desire to use gas for private lighting, and whom the local gas company declined to supply. For this purpose, the Peoples Gas Company was organized and a franchise secured for the purpose of manufacture, distribution and sale of gas throughout Irvington and adjoining townships. The manufacture of gas has not yet been begun, however, as the old gas company decided to lay mains where wanted and supply such customers as applied.

A FIRE AND ITS BENEFICENT RESULTS.

On December 29, 1896, a fire occurred in the River station at Newark which was the beginning of a marked change in the ap-

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paratus and system used by the company. Although the cause of this fire was never positively determined, it undoubtedly originated from the current itself and was probably caused by an accidental short-circuiting of some of the main leads connect-

THE RIVER STATION, NEWARK, N. J., BEFORE THE FIRE.

ing dynamos to the switchboard. Up to the time of the fire the installation of engines and dynamos at the River station consisted of a miscellaneous lot of high-speed engi. es, medium-speed engines, and dynamos of different makes and units; the

INTERIOR OF RIVER STATION, NEWARK, N. J., BEFORE THE FIRE.

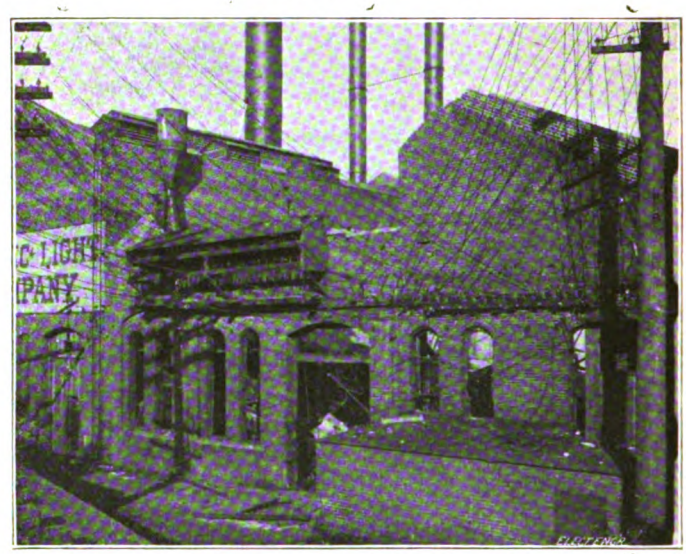
alternating current being of 1,000 volts potential, 16,000 alternations and the generators of an average speed of 1,300 revolutions.

The fire started about six o'clock on the evening in question, and within an incredible short space of time the entire building

SPECIAL TRAIN OF BRUSH ARC LIGHT APPARATUS SENT FROM CLEVELAND TO NEWARK IN THREE HOURS LESS THAN SCHEDULE PASSENGER TIME.

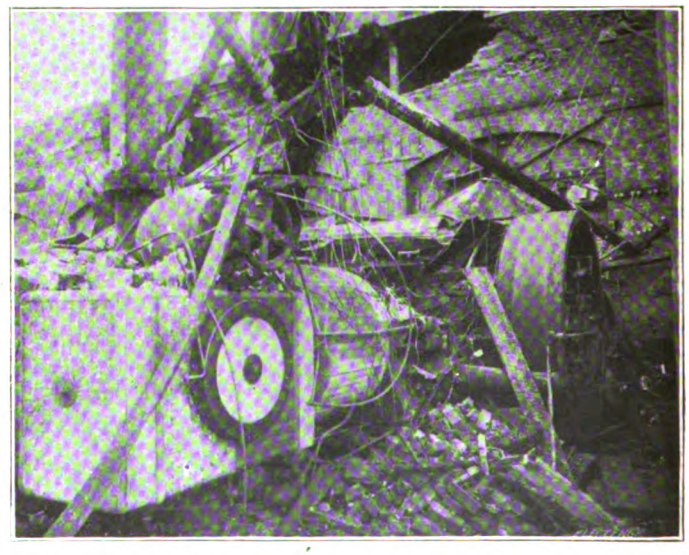
was a mass of flames, so that all hopes of saving any portion of the machinery or apparatus were promptly abandoned, and efforts were confined to preventing the fire from spreading.

In connection with this fire, one of the greatest examples of "hustle" in the matter of replacing lost property in the experience of the business was shown. The station at the time of the fire consisted of something over 4,000 horse power in the different classes of service furnished by the company, and at midnight not only was every piece of apparatus completely burned out and destroyed, but there was not within the County of Essex at the time a single piece of electrical apparatus adapted to the system then employed. Before the fire had burned more than fifteen minutes, an officer of the company on the ground seeing the hopelessness of saving any of the apparatus, began a series of telegraphic inquiries to every reliable maker of apparatus in the country, as well as to all large central station companies in-



EXTERIOR OF RIVER STATION THE DAY AFTER THE FIRE.

quiring what apparatus (if any) could be loaned temporarily. As a result of these inquiries, and also as an evidence of the good standing of the company, numerous offers began to pour in. Every possible means of expediting the work of loading, transporting and setting the apparatus was employed. In one case a shipment consisting of eighteen arc machines obtained from the Brush Company, at Cleveland, was put aboard a special train. Special engines were secured and employed, and a right of way



A CORNER IN THE RIVER STATION, NEWARK, N. J., THE DAY AFTER THE FIRE.

secured from the management of the Pennsylvania Railroad Company. Messengers were placed aboard the train who reported progress at each stop, and as a result a train of seven cars loaded with machinery, specially to replace the burned out apparatus, was able to make the trip to Newark in three hours less time than the regular passenger schedule! While these ar-

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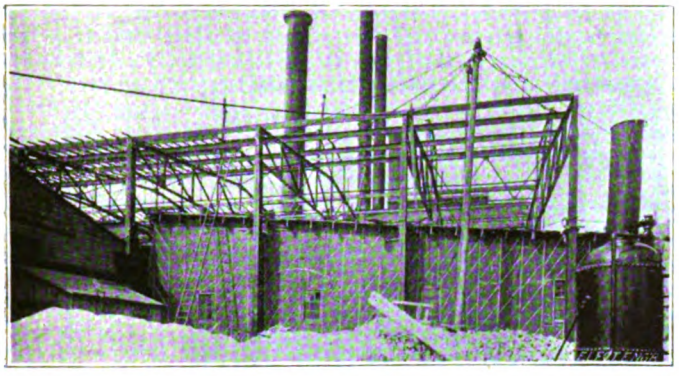
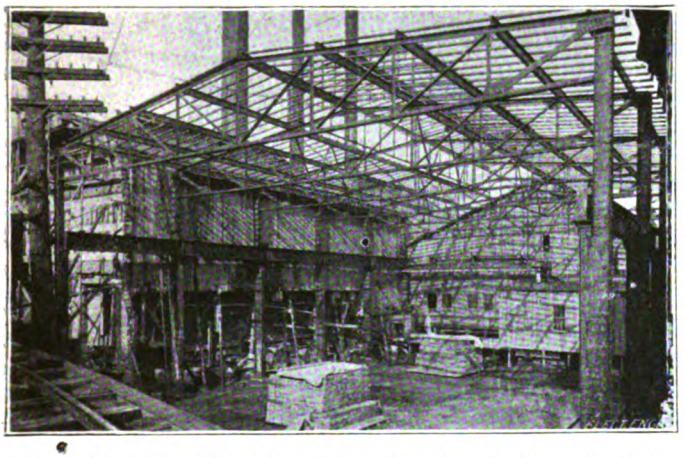
rangements were being carried out, two or three smaller dynamos were borrowed from Paterson and New York. Likewise temporary engines were rented in machine shops, factories and simi-



CONSTRUCTION OF NEW RIVER STATION OVER TEMPORARY STATION, WHILE RUNNING OVER 2,000 H. P.

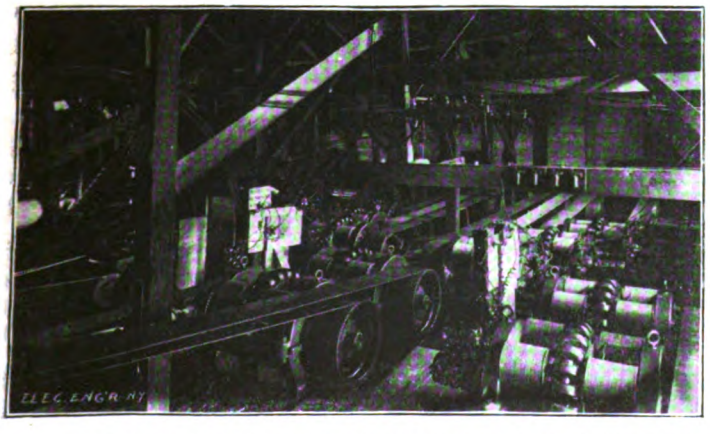
lar places in Newark, so that in less than eighteen hours after the occurrence of the fire more than five hundred arc lights were burning on the streets of Newark on schedule time.

While the arc light dynamos were being transported from



STEEL FRAME CONSTRUCTION OF NEW RIVER STATION, NEWARK, N. J.

Cleveland to Newark some incandescent dynamos were being rushed along in a similar manner from Pittsfield, Mass. Three dynamos were obtained, one at a time, from the Stanley Electric Manufacturing Company, whose shops are at that place.



ARC DYNAMO ROOM DURING CONSTRUCTION OF NEW RIVER STATION.

These dynamos were shipped in box cars, each one of which was attached by special permission to the express trains running between Pittsfield and New York, over the New York Central. Upon the arrival of the train in New York special floats and tugs were employed to transfer the car to Jersey City, and special locomotives provided to haul it to Newark. Through the courtesy of the officers of the Pennsylvania Railroad Company, four tracks of their siding at Market street were reserved for the use of the company, and all shipments of apparatus were directed to this yard. By similar methods adopted in every department and by

DELIVERING THE FIELD OF ONE OF THE 850 K. W. GENERATORS AT THE RIVER STATION, NEWARK, N. J.

incessantly following up and arranging matters, the company were able to resume service on all their circuits within three days from the time of the fire. Of course the lights, being operated by a multitude of small units located at numerous convenient points were not examples of modern practice, but served the purpose until better arrangements could be made.

Mechanic street station, described above, which had been abandoned in May, 1895, was opened up. The engines and boilers which had been lying in idleness since shutting down this plant were promptly overhauled and repaired, and additional

COAL TRESTLE AND UNLOADING CRANE, RIVER STATION, NEWARK, N. J.—INSIDE CRANE ON CAR.

engines and boilers erected. A complete equipment of dynamos furnished by the Stanley Company was purchased and operations of a semi-permanent character were started.

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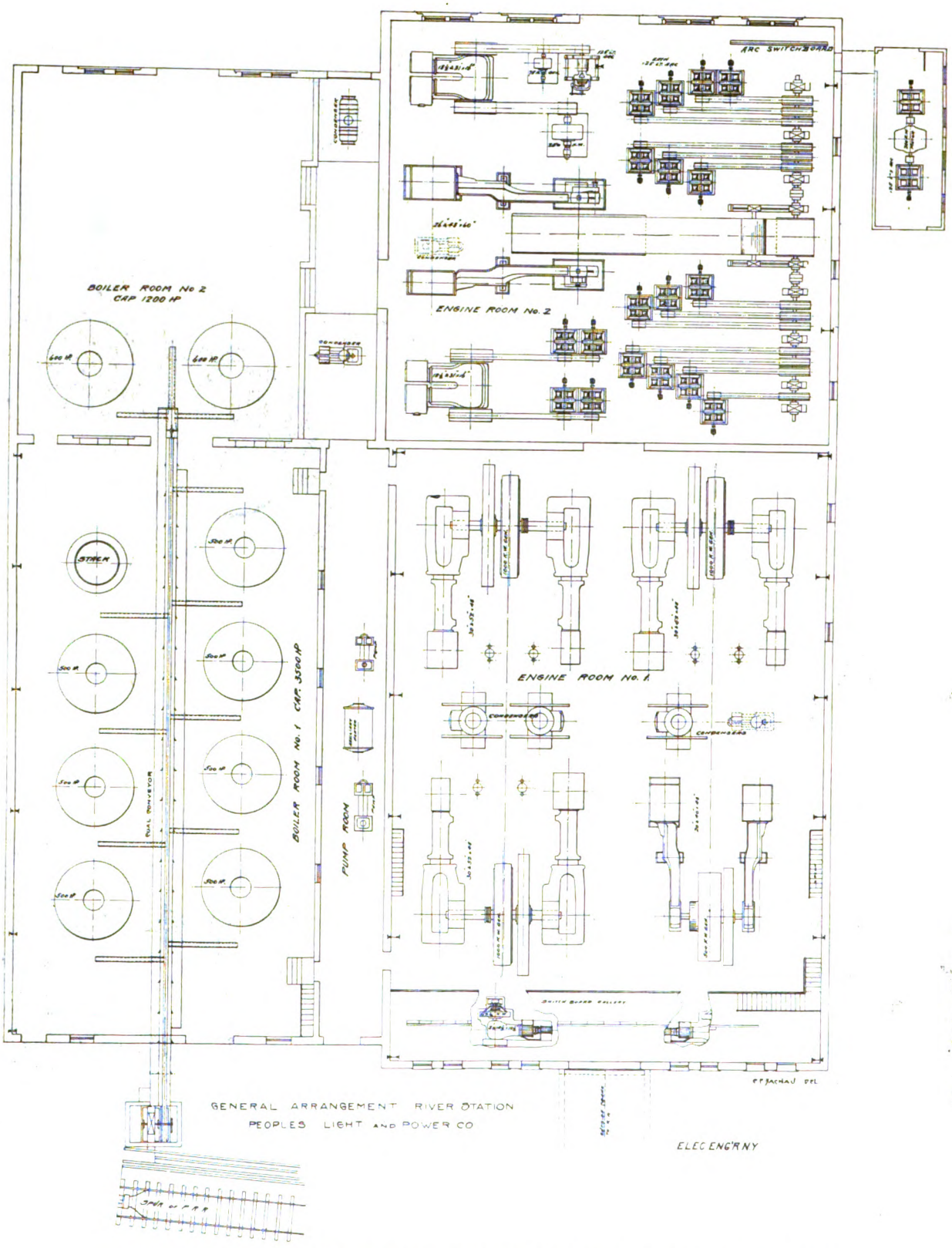

GROUND PLAN SHOWING GENERAL ARRANGEMENT OF RIVER STATION, NEWARK, N. J.

The adjustment and settlement of the loss occasioned by this fire occupied more than four months and was accomplished by arbitration.

THE NEW RIVER STATION.

The new River station, the construction of which was begun in the fall of 1897, is admirably situated upon the west bank of the

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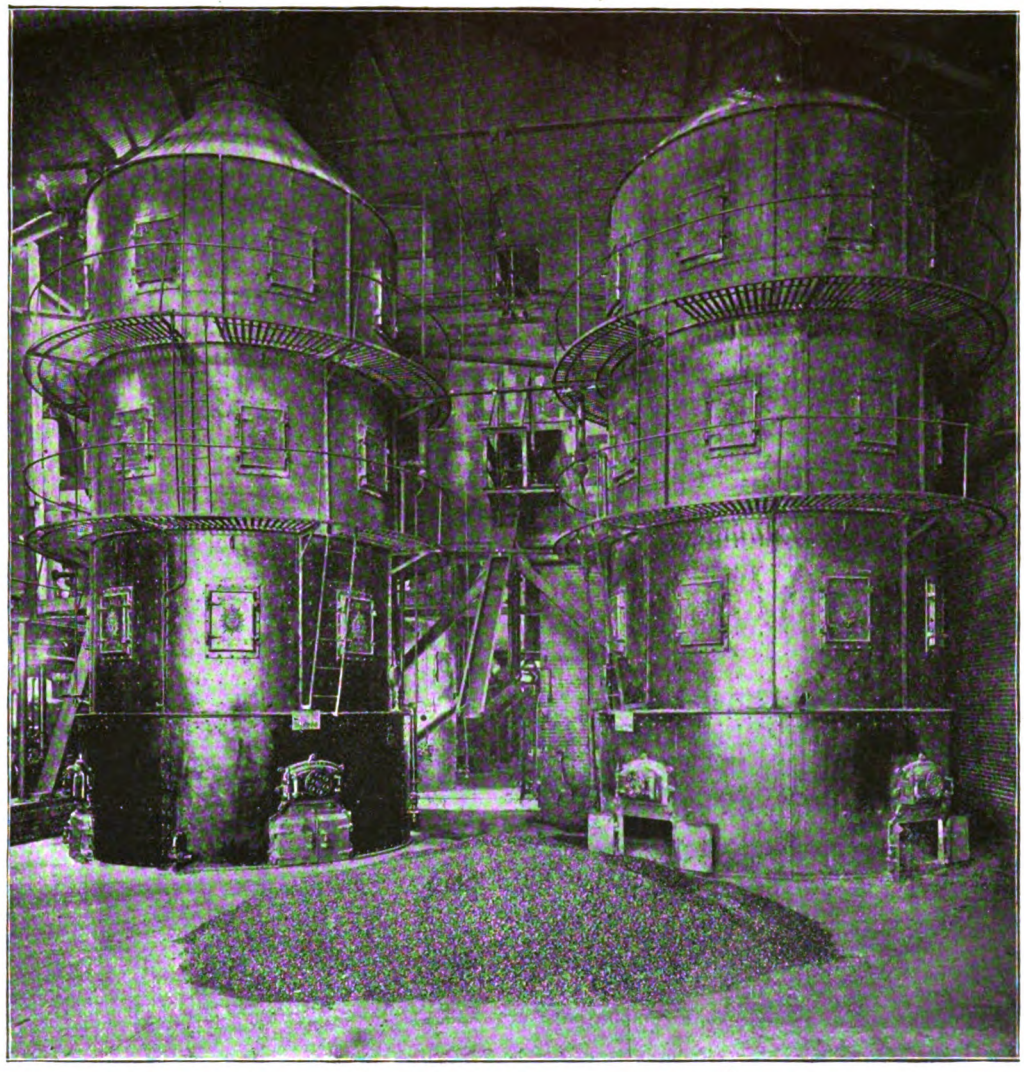
Passaic river, to the right side of the Pennsylvania railroad entering Newark, and is located between the main line and the Centre street branch of that road. A spur is run to the west side of the power house.

The power house, shown in plan, occupies a space of 173 by 136 feet; is of steel frame, bricked in with tile roof and cement floor, and is divided (longitudinally) by a wall which cuts the building into two parts, one part being occupied by the two boiler rooms, which are again divided by a brick wall, the other constitutes the engine room, also divided into two sections by a brick wall. The new section of the power house, known as engine room No. 1, is constructed on piles driven 2 ft. 6 in. centres, which are capped by a mass of concrete 4 ft. thick, upon which are built the several engine foundations. The flooring is constructed of I beams, upon which is laid the concrete flooring in flat arches.



BOILER ROOM NO. 2 AT THE RIVER STATION OF THE PEOPLES LIGHT AND POWER COMPANY, NEWARK, N. J., CONTAINING TWO 600 H. P. MORRIN "CLIMAX" BOILERS.

This flooring is of the Ransom system, constructed by Mr. J. Sharpe. The wainscoting is of enamelled brick to a height of about 8 ft., above which the walls are painted white. The roof is constructed of fireproof book tiles, upon which is laid the weatherproof roofing. A monitor is constructed on the roof running the entire length, giving ample ventilation. The switchboard gallery, which is about 12 ft. wide, extends across the entire west end of the building. A 25 ton crane spans the width of the building, and was furnished by Alfred Box & Co., of Philadelphia.

Another crane, of the same capacity, furnished by Box, spans the distance between the large door of engine room No. 1 and the railroad, and gives ample facilities for unloading machinery from the cars to the building.

Engine room No. 2 is only partially new, having had parts of the walls and a new roof constructed, making it similar in appearance to engine room No. 1. A 15 ton crane for this room, furnished by Box, is now in course of construction.

STEAM EQUIPMENT.

Boiler room No. 1 has been practically rebuilt, having had the front wall moved out 10 feet to make room for two new boilers, and the side wall taken down and rebuilt on piles; steel columns being added to support the roof, which is of corrugated iron.

A space 10 feet in width and running the entire length of the engine and boiler rooms No. 1 and directly against the wall between these rooms, is utilized as a pump and heater room, and consists of a 12 inch wall supporting the steel I beams which form a roof to this room; the space between the beams being filled in with concrete flooring. Through the basement, under the floor of this room are run the injection and overflow pipes to the station.

Boiler room No. 2 is the only section of the power house that stands in its original condition, and it has room for four new boilers.

Coal is delivered by the Pennsylvania Railroad upon the spur siding before mentioned, from which it is dumped into coal pockets located under the tracks, from whence it is carried by a conveyor, furnished and erected by the Link Belt Engineering Company, to the battery of seven 500 horse power "Morrin" Climax boilers located in the boiler room No. 1 and to the two 600 horse power boilers of the same make located in the boiler room No. 2 with an aggregate of 4,700 horse power. These boilers supply steam at a pressure of 145 pounds to the 14-inch main, which is supported by adjustable wedges, placed

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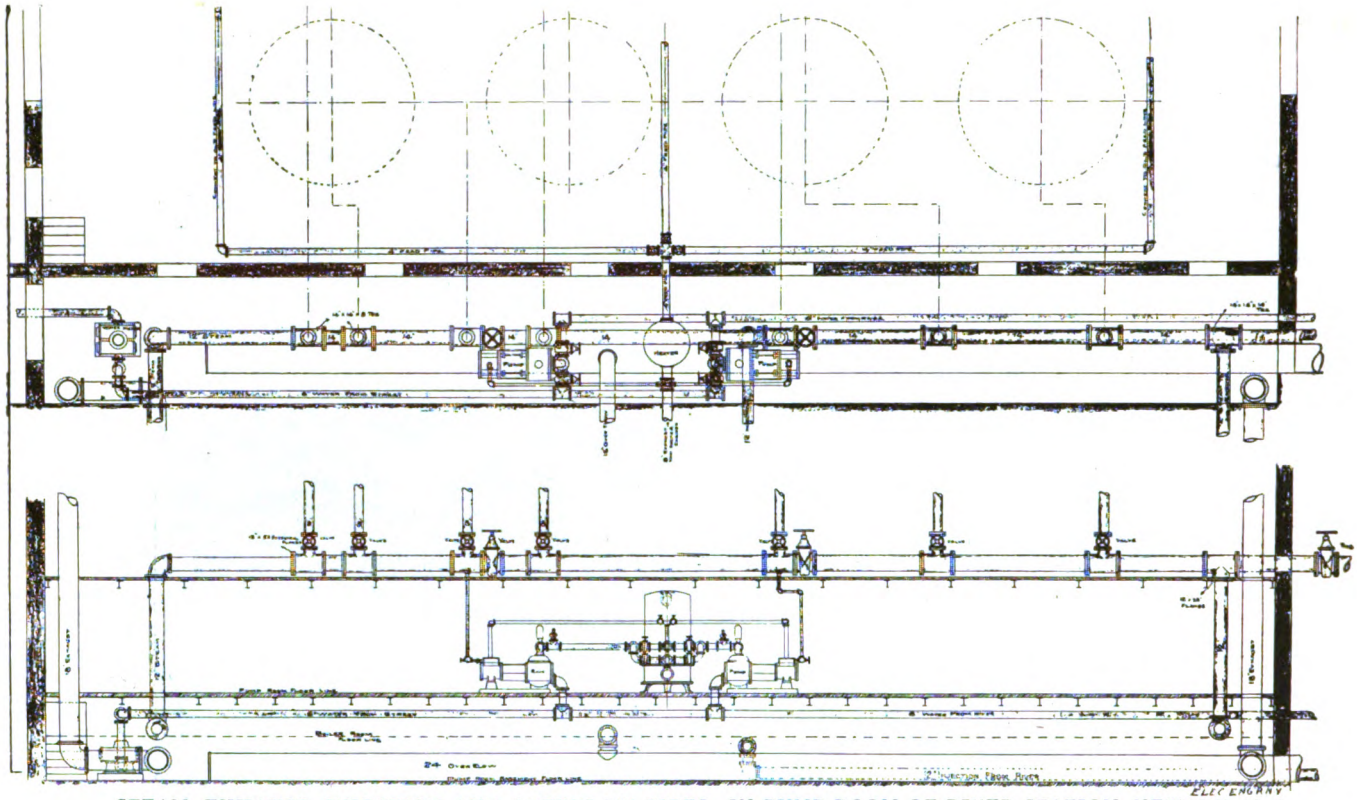
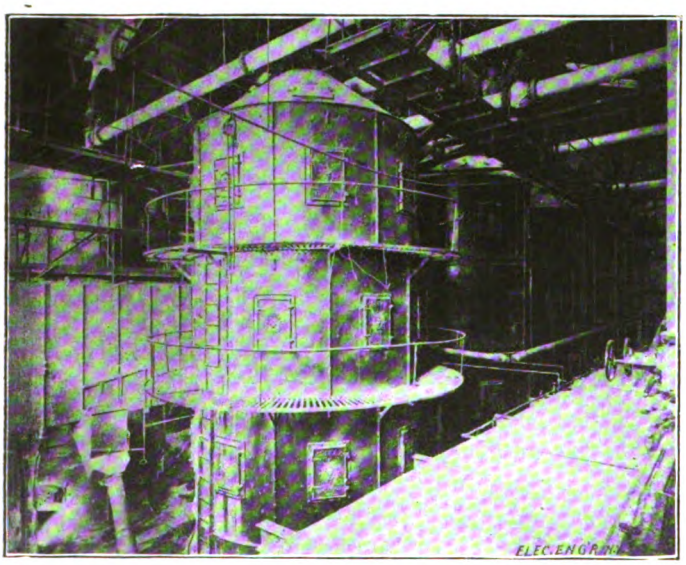


STEAM, EXHAUST, INJECTION AND OVERFLOW PIPES IN PUMP ROOM OF RIVER STATION, NEWARK, N. J.

upon the I beams in the pump room ceiling. The ends of the main are joined together by a 12-inch loop which runs through the centre of the engine room No. 1. This enables each engine to be run from either end of the main, which is subdi ıded by valves in such manner that any section may be cut off without affecting the rest of the main.

PIPING SYSTEM.

The piping system, was installed by Westinghouse, Church, Kerr & Co., of New York, under the direct supervision of Mr.

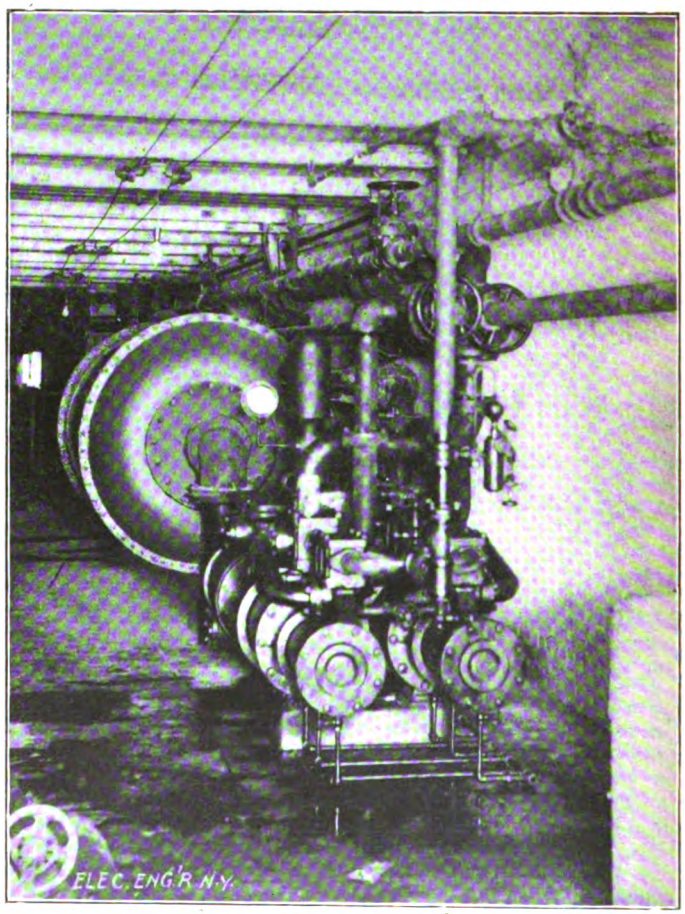


BATTERY OF SEVEN MORRIN "CLIMAX" BOILERS, CAPACITY 3,500 H. P., RIVER STATION, NEWARK, N. J.

Wm. Andrews, the recognized authority on high pressure piping. All fittings are extra heavy, and the piping is covered with the Nonpareil Cork Manufacturing Company's covering. The pipe is dripped into a Holly system, which returns the condensation to the boilers.

ENGINES AND DYNAMOS.

The equipment in engine room No. 1 when completed, will consist of three Pennsylvania Iron Works Company's 30 by 52 by 48 cross-compound condensing engines, each directly connected to a Westinghouse 850 k. w. two-phase a. c. generator, generating 2,300 volts at a frequency of 60 cycles and a speed of 90 r. p. m.



WORTHINGTON PUMP AND AMERICAN FEED WATER HEATER IN PUMP ROOM, RIVER STATION, NEWARK, N. J.

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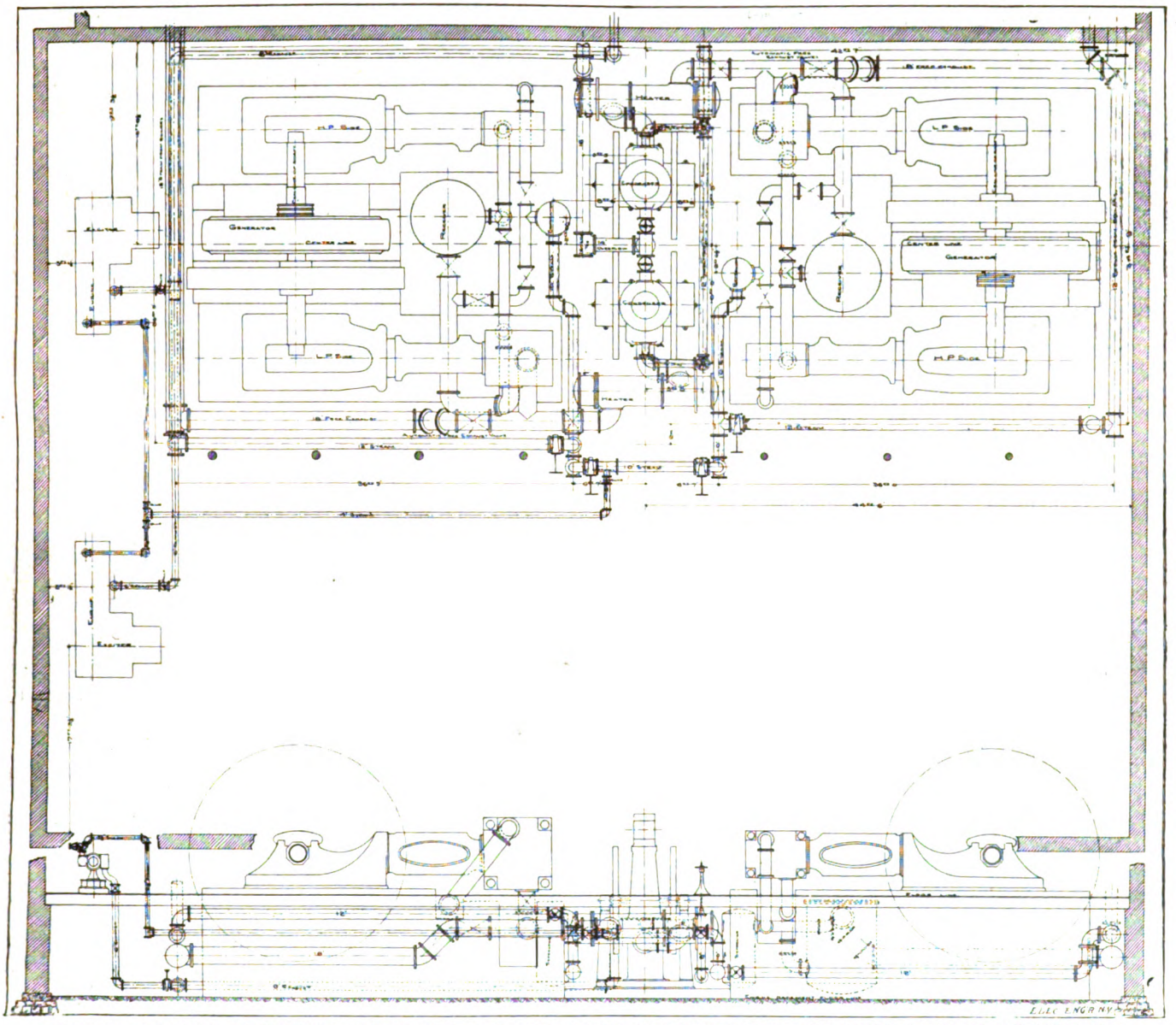
These dynamos are of the two-phase rotary field type, and are excited through a collector on the shafts. They are designed with a view of being of a higher all-round efficiency and a larger margin than is usual in the case for such work. For example: They are designed and guaranteed to carry their full rated loads at a rise in temperature not to exceed 35 degrees C. in any part of the machine, and a continuous overload of 60 per cent. above their normal rating, with a total rise in temperature not to exceed 60 degress C. and to carry an overload of 75 per cent. for one hour with a total rise in temperature not to exceed 75 degrees C. The fly-wheels of the engines are of special interest, the wheel proper being in eight sections of cast steel, linked together in the usual manner. Each side of the rim is built up of seven layers of steel plates, each layer breaking joints with the succeeding one. The whole mass is then riveted together, weighing 100,000 pounds. The generators supply the current for the incandescent lighting, having a capacity of 50,000 lights. They are excited by two 62 k. w. Westinghouse generators direct connected to 8x14½x10½ tandem-compound McIntosh & Seymour engines, run at a speed of 275 r. p. m. These exciters are run in parallel, and each is of sufficient capacity to excite all the alternators and light the station. There is also one 20x40x48 Watts-Campbell cross-compound engine direct connected to a 500 k. w. 500 volt Westinghouse direct-current generator, which is used to supply the current for the power circuits, running at a speed of 90 r. p. m. This engine exhausts into a Worthington horizontal jet condenser.

All the engines are arranged to operate singly with either cylinder. The exhaust from the Pennsylvania engines is connected, through a 1,500 horse power horizontal Goubert Manufacturing Company's feed water heater to the specially designed jet condensers of the engine type, made by the Pennsylvania Iron Works Company. Two 12-inch cast-iron flanged injection pipes, run from the river—through the pump room cellar—supply water to the various condensers. A 20-inch cast-iron bell and spigot pipe, also run in the pump room cellar, carries the overflow water from the condensers, discharging it into the river.

In engine room No. 2, which is devoted to the arc lighting, are located the eighteen 125 light Brush machines which furnish the larger part of the current to 2,700 arc lights. Fourteen of these arc machines are belted to a shaf twhich is driven by a 26x48x60 Watts-Campbell cross-compound condensing engine. There are also located in this room two 18½x31x16 Armington & Sims cross-compound condensing engines, one of which drives four arc machines; the other drives one Western Electric Co. day arc machine, a 250 k. w. volt direct-current Westinghouse generator, used for power, and a 75 k. w. direct-current Westinghouse 220 volt power generator. One of these A. & S. engines exhausts into a Worthington horizontal jet condenser, and the other into a Wheeler horizontal surface condenser. The Watts-Campbell engine above mentioned exhausts into a Worthington horizontal jet condenser.

In the annex to engine room No. 2 is run a Westinghouse two-phase 2,000 volt alternating current induction motor, which



STEAM, EXHAUST, INJECTION, OVERFLOW AND FEED PIPES IN ENGINE ROOM OF RIVER STATION, NEWARK, N. J.

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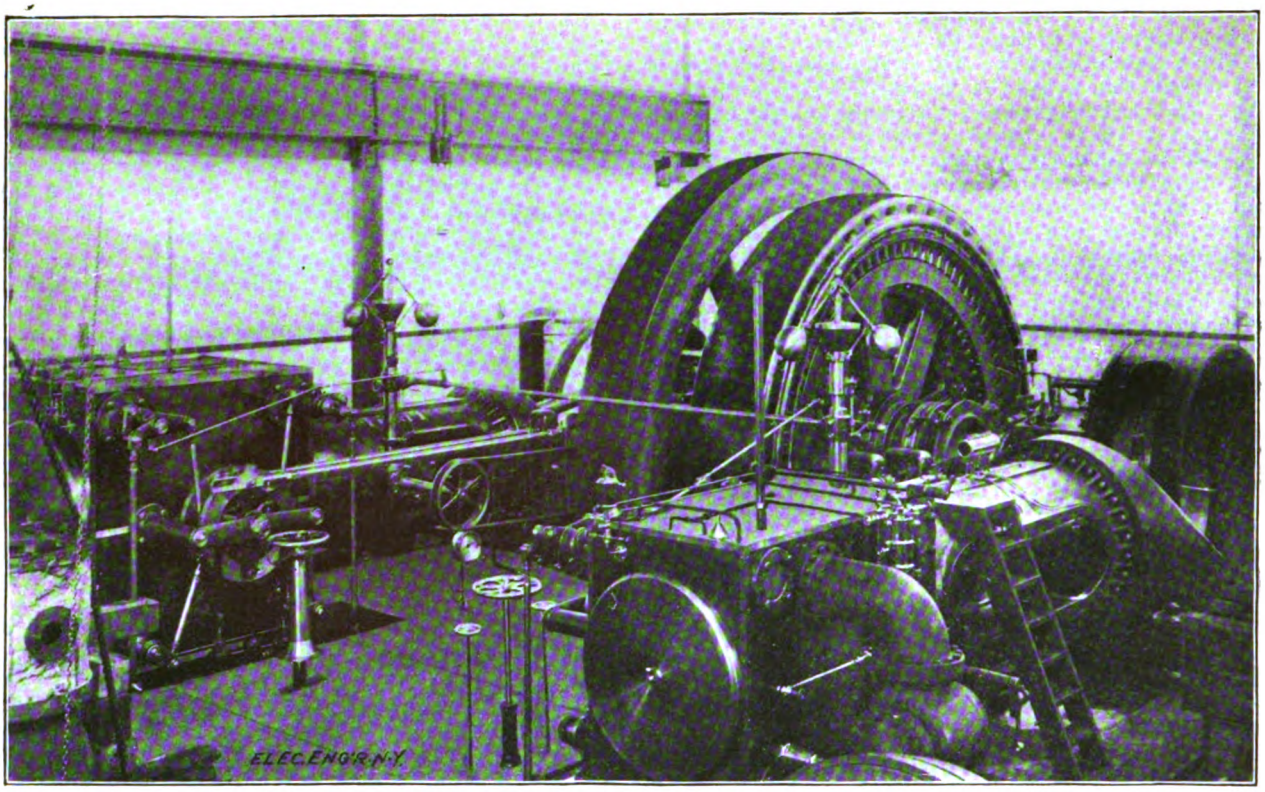


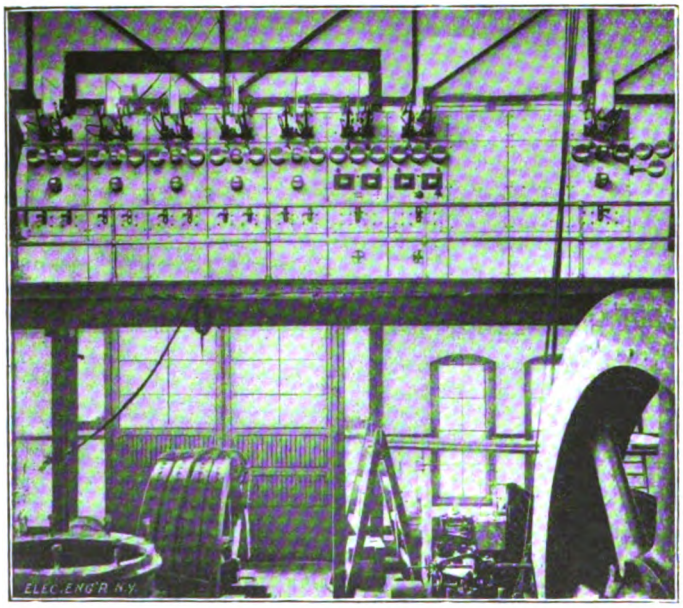
A GENERATING UNIT AT THE RIVER STATION, NEWARK, N. J. PENNSYLVANIA IRON WORKS CROSS-COMPOUND CONDENSING ENGINE DIRECT CONNECTED TO A WESTINGHOUSE 850 K. W. A. C. GENERATOR.

is directly connected by means of flexible couplings at each end of the shaft to two 125 light Brush arc machines, used to operate day arc lights.

All the conductors in engine room No. 2 are lead covered run in conduits of the National Conduit and Cable Company's manufacture under the concrete floor.

SWITCHBOARD.

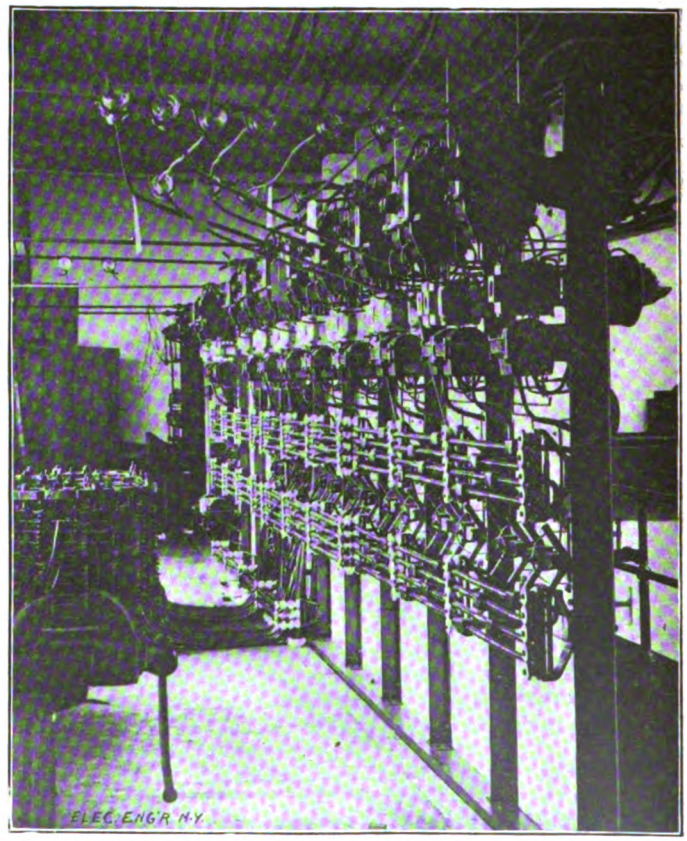
The switchboard located upon the gallery in engine room No.



FRONT OF SWITCHBOARD, RIVER STATION, NEWARK, N. J.

1 was constructed and erected by the Westinghouse Company, and is of blue Vermont marble. It consists of two exciters, and one station lighting panel, three alternating current generator panels, eight double incandescent circuit panels, two 500 volt direct-current generator panels and two 500 volt and one two-phase power panels.

The generators are all connected to their respective panels by heavy insulated cables, which are supported by porcelain insulators set in iron racks secured to I beams; there being six conductors to each generator.



BACK OF SWITCHBOARD AND RHEOSTATS, RIVER STATION, NEWARK, N. J.

Wires are run under the floor, except where they rise on the side wall at one end of the gallery running on the I beams which

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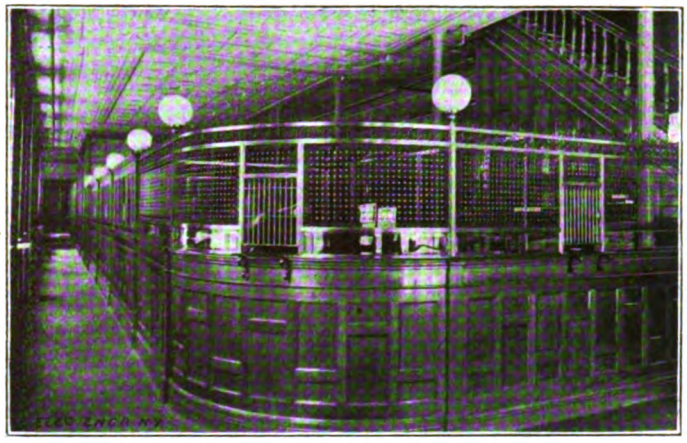
support it to their respective panels, to which they are connected through a slot in the slate floor.

GENERAL OFFICES OF THE PEOPLES LIGHT & POWER CO., 209 MARKET ST., NEWARK, N. J.

The alternating current switchboard is designed primarily for parallel running. Duplicate sets of two-phase bus-bars have been provided, and the generator and feeder panels are equipped with double-throw switches. Any generator can, therefore, be run separately from the others, and any feeder operated from it, should the nature of the load make it desirable to do so.

All switches, connections and wiring are behind the board. Upon the face of the board are mounted only the switchboard instruments and the handles which control the switches themselves. The generator panels contain the necessary synchronizer devices with an ammeter and indicating voltmeter for each phase. A direct-current ammeter is provided for the field circuit. Voltmeters are mounted on swinging arms at the end of the board. Each feeder circuit is provided with an ammeter and recording wattmeter. Circuit regulators are also provided with compensating voltmeters and Mershon compensators.

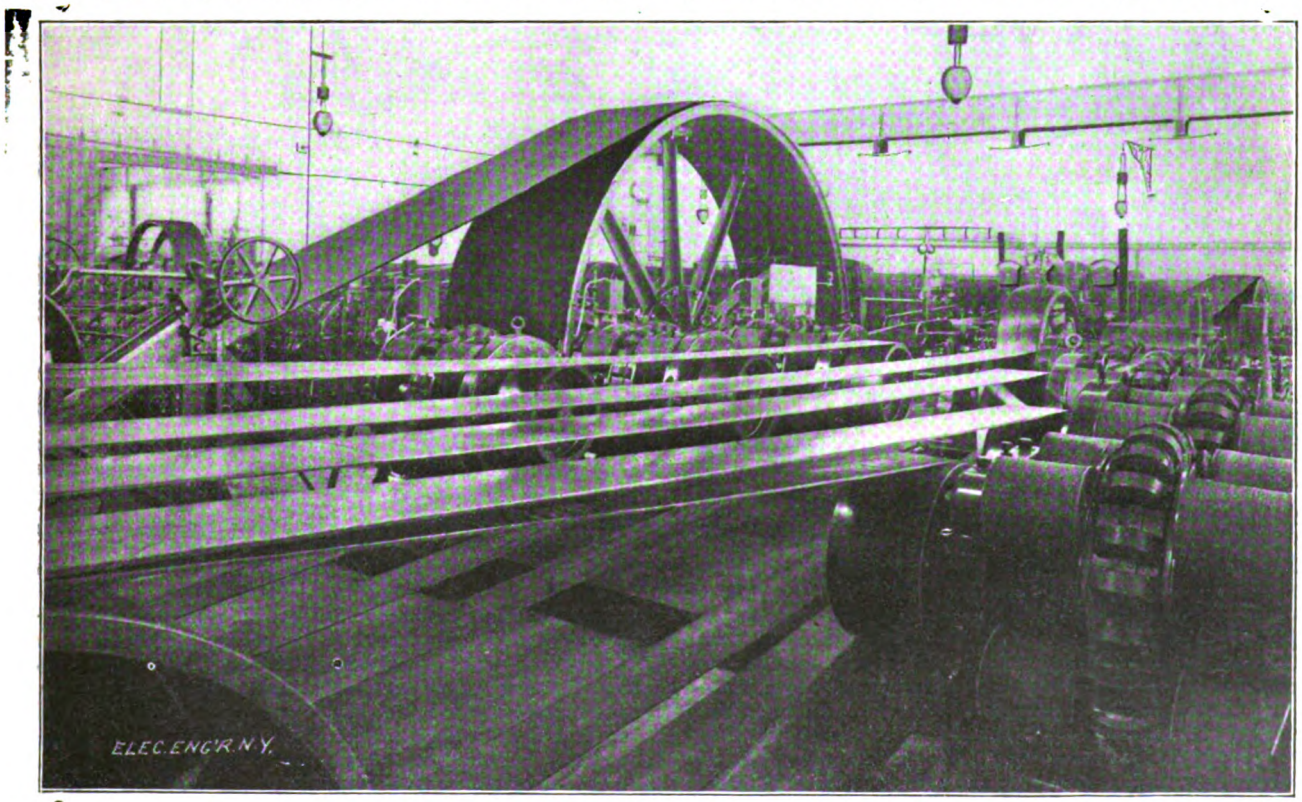


BOOKKEEPING DEPARTMENT OF PEOPLES LIGHT AND POWER COMPANY, NEWARK, N. J.

The 500 volt panels are provided with volt and ammeters and circuit breakers. The lighting and power circuits are run from their respective panels along the under side of the gallery to iron racks from whence they are run through slate slabs located in windows.

AUXILIARY EQUIPMENT.

Oiling System.—The oil system is installed on the gravity principle, getting its pressure from a supply tank of sufficient capacity located above the pump room, and about 25 feet above the elevation of the engine room floor, giving a pressure of about 12 pounds.



EIGHTEEN 125 BRUSH ARC GENERATORS, RIVER STATION, NEWARK, N. J.

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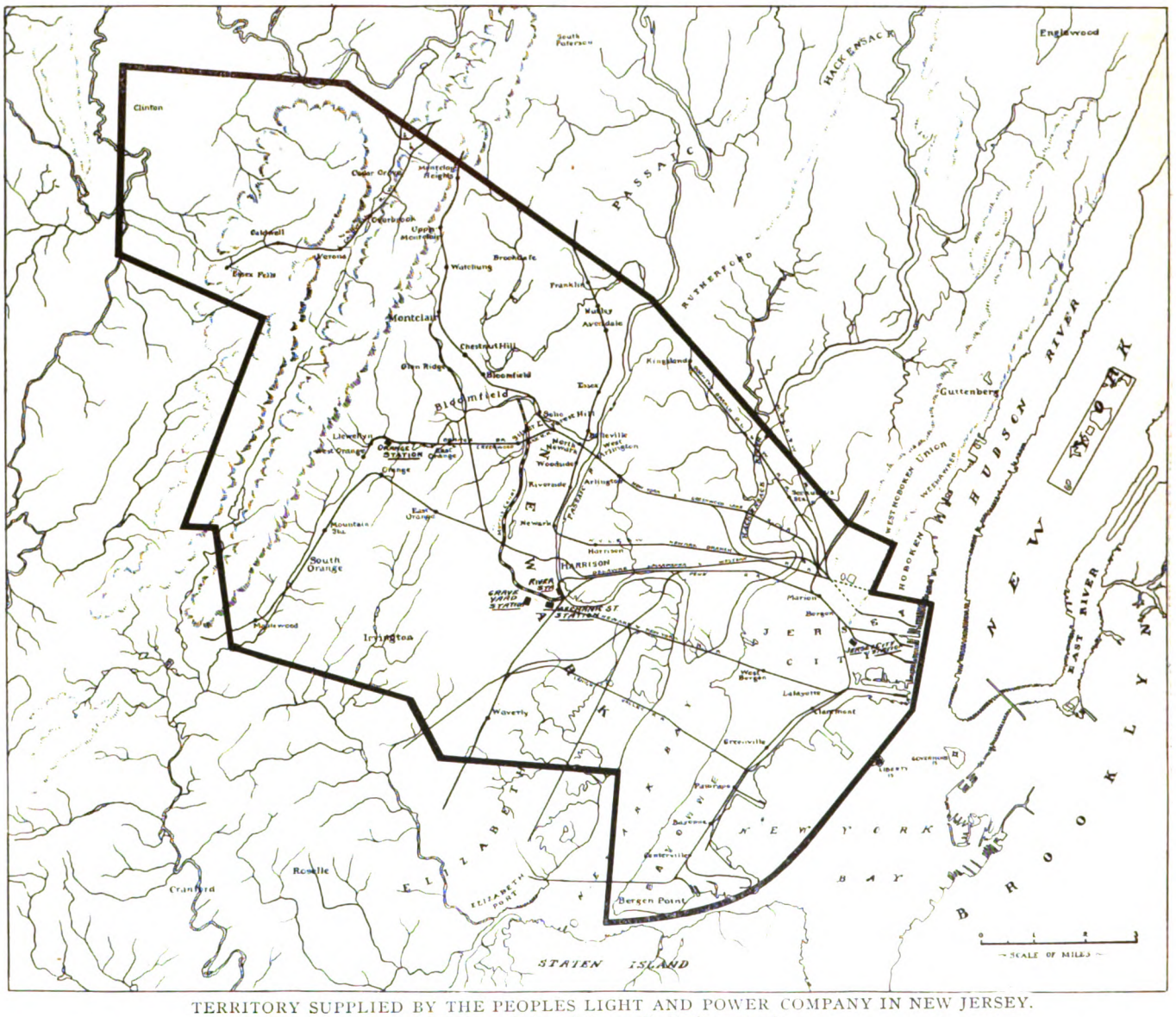
Supply mains are run from this tank to the several engines in both rooms, and are concealed under the floor, except where they rise to the brass piping on each side of the engines, feeding the several cups. After the oil is run through the bearings, it is carried from the engines by return pipes and gravity to a filter located in the pump room cellar, from whence, after being filtered, it is elevated with a pump to the supply tank. This system was installed by Westinghouse, Church, Kerr & Co.

Air System.—A Westinghouse air compressor is installed in the basement of engine room No. 1, from which pipes are run connecting with the several outlets in both engine rooms. To these outlets is connected the flexible rubber hose that is used for blowing the dust and dirt out of the machines.

MUNICIPAL CONTRACTS AND PRESENT STATUS OF THE COMPANY.

As we said at the outset, one of the most remarkable and praiseworthy achievements of the Peoples Light & Power Co. is their success in dealing with municipal authorities and obtaining municipal contracts. The territory which they supply with current for light, power and various other purposes, is shown on the acompanying map, and, as will be seen, it includes several cities and towns of considerable size and population. That section of the country, embracing numerous New York suburbs and important landing places for foreign vessels, is constantly increasing its population and gaining in importance, and the company's history written yesterday no longer represents its status one week hence. In fact so kaleidoscopic and rapid is its development, that we are compelled to state that the figures given below were approximately correct on December 16, 1898.



TERRITORY SUPPLIED BY THE PEOPLES LIGHT AND POWER COMPANY IN NEW JERSEY.
(Stations are indicated by small, black squares.)

Feed Water System.—Special attention has been devoted to the feed water system which is substantially as follows: Two connections from the city water main and emergency connection from the river are run to two feed water pumps, one a Blake duplex, and the other a Worthington compound, located in the pump room, either one of which is of sufficient capacity to feed all the boilers. The water is pumped from these pumps through the Goubert heaters, located between the Pennsylvania Iron Works Company's engines and their respective condensers from whence it runs through the auxiliary American heater located in the pump room. From this heater the piping system is run in a loop around either side of the boiler room, and is so arranged with valves that any section may be cut out without affecting the rest of the piping.

At that time the company furnished current for arc and incandescent lighting, or power, in Newark, Clinton township, Irvington, Vailsburgh, South Orange, West Orange, Orange, East Orange, Caldwell, Verona, Montclair, Glen Ridge, Bloomfield, Belleville, Kearney, Harrison, Jersey City and Bayonne .and had contracts for municipal lighting in all of these towns except South Orange Village, Glen Ridge and East Orange, in which places gas contracts are at present in force, but have a short time to run.

The company has made voluntary reductions in its rates from time to time, always leading the gas companies in that respect, until at the present time its rates for lighting and power are said

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to be lower than in any other place in the country, operating under similar conditions of coal and water supply.

The capacity of the three generating centres, on Dec. 16, 1898, was as follows:

	Arc.	Incand.	Power.
Newark	3,000	50,000	850 k. w.
Jersey City	1,700	10,000	350 k. w.
Orange	750	10,000	500 k. w.
Total	5,450	70,000	1,700 k. w.

Or counting one arc lamp as equivalent to ten, and one kilowatt equal to twenty incandescent lamps, we get a total of 158,500 units.

MANAGEMENT AND OFFICERS OF THE COMPANY.

The company's main offices, shown in the illustration, are located at the corner of Market and Beaver streets, Newark, N. J. The emblem of the company, two American flags crossed and surrounded by the inscription, "Matchless Light," adorns the front of the building, which is beautifully illuminated at night. The front part of the spacious ground floor is utilized as the bookkeeping department. In the rear of this floor is located the company's showroom, where they exhibit the various apparatus for which they supply current, such as arc and incandescent lamps, motors, heating devices, etc. On the next floor are located the company's general offices, from which the entire business of the company is directed and controlled. These offices are connected by a private telephone exchange with all branch offices and stations, as well as all departments in the general office. These branch offices are located at Orange, Montclair, Bloomfield, Kearney, Jersey City and Bayonne.

By this method of intercommunication, all orders, contracts, purchases, supplies, construction and operation are regularly reported, so that in spite of the large extent of the territory covered by the business, the management is kept constantly informed of the condition of affairs in all departments.

The officers of this enterprising and progressive company are: President, Philip N. Jackson; Vice-President, Gottfried Krueger; Treasurer, Leslie D. Ward; Secretary, L. D. H. Gilmour; Assistant Treasurer and Assistant Secretary, Percy Ingalls; General Manager, Dudley Farrand; General Superintendent, Paul Spencer; Board of Directors: F. Wolcott Jackson, Thomas T. Kinney, Gottfried Krueger, James E. Reynolds, Charles A. Sterling, Leslie D. Ward, Randal Morgan, William Fairlie, Samuel Klotz, Peter Hauck, Jr., Joseph D. Bedle, James G. Hasking, P. Sanford Ross, William C. Shanley, Abram C. Denman, William M. Clarke, E. F. C. Young, William G. Bumsted, John F. Kehoe, Uzal H. McCarter, William Scheerer, Charles M. Decker, A. Q. Garretson, Matthias Plum, Jr., William Runkle, Dudley Farrand, John D. Harrison, Philip N. Jackson, B. M. Shanley.

The division superintendents, who have under their immediate control and jurisdiction all construction and operation in their particular division, are: Newark, John J. Gaffney; Orange, Walter A. Huston; Jersey City, W. W. Titzell. These three gentlemen have had a long and varied experience in central station work, and this, combined with rare executive ability, has fitted them admirably for their responsible positions.

Though it may be difficult in tracing the growth of a company to give due credit to each individual officer or employé who has contributed materially to it by his own efforts, energy and foresight we have before us a case where individual merit stands out so prominently that we cannot deny it special mention. We refer to the Genl. Manager, Mr. Dudley Farrand, who has been connected with the company in one capacity or another ever since its inception, and has, by his great skill in directing the business as well as the engineering end of the company, raised it from its small beginning to its present prominent position. He has been ably assisted of late years by the General Superintendent, Mr. Paul Spencer who, although not until comparatively recently connected with the company, has had a wide and valuable experience in the construction and operation of electric plants, both for lighting and railway work, and in the manufacture of electrical generating apparatus; and also the Superintendent of Construction, Mr. Paul C. Oscanyan. To these gentlemen we are greatly indebted for the aid extended to us in the preparation of this article.

Dudley Farrand, General Manager. Philip N. Jackson, President. Paul Spencer, General Superintendent.

CHIEF OFFICIALS OF THE PEOPLES LIGHT AND POWER COMPANY OF NEW JERSEY.

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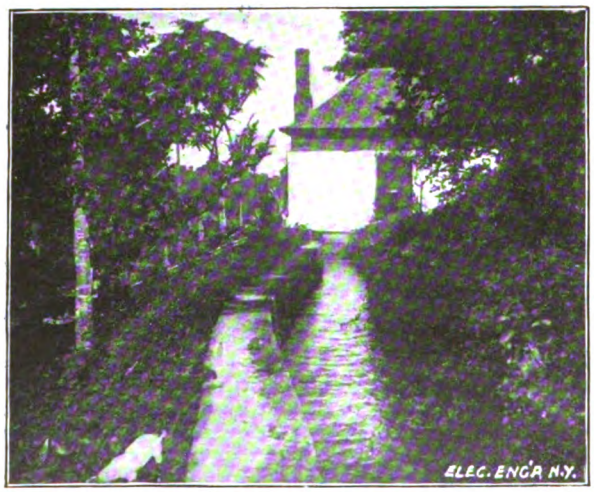
An American Light and Power Plant, Montego Bay, Jamaica, West Indies.

SMALL water powers were abundant in the Island of Jamaica in the days before beet sugar competition, native lack of enterprise and dependence on paternal government had ruined the sugar industry. Almost every estate developed a small water

VIEW OF DAM FOR MONTEGO BAY ELECTRIC LIGHTING PLANT.

power, usually about 30 h. p., and the ruins of dams and aqueducts may be found in all parts of the island, some of them so overgrown with tropical bush that it is difficult to trace them at all. It is one of these ruins, located at the mouth of Great River, eight miles from Montego Bay, the largest town on the north side of the island, that has been transformed into an electric light and power station by the Montego Bay Electric Co., Ltd.

About 1¼ miles up the river, three falls give a head of about 25 feet, the highest fall being farthest up stream, where a lot of huge boulders resting on a ledge of bedrock have formed themselves into a barrier across a gorge through which the river runs, making a natural dam. This gave water for the sugar works, but in order to get enough for the electric plant it became necessary to raise this natural dam and to fill up a hole in it about 8 feet wide and 14 deep, through which most of the water in the river passed under a head of about 10 feet. This work gave considerable trouble and required very careful handling, owing to the great rush of water through the hole. It



FOREBAY OF CENTRAL STATION, MONTEGO BAY.

was filled with boulders and large stone in a cribwork, the stone and boulders weighing many tons being rolled down the steep banks guided by a rough shute of logs. A dam of rough stone in cement concrete was then built across the top.

The gutter carrying the water to the old mill house is 1⅛ miles long, and was originally built by slave labor, something over 100 years ago. It was built of cut stone set in lime mortar mixed with ashes and sugar or molasses. This mortar has become so hard that in some places where alterations were necessary, the walls had to be blasted out with dynamite, the mortar being as hard as the stone itself. In other places where repairs had been made by the unreliable labor now found in Jamaica, the work was so bad that a machete could be pushed through the wall anywhere. The grade of the gutter had to be increased to nearly 6 feet to a mile on account of the small cross-section and many curves in the gutter.

The design of the hydraulic plant comprises two 24 inch Samson wheels made by the Jas. Leffel & Co., each connected to the end of a short jack shaft by a friction clutch, the jack shaft carrying two friction pulleys belted to the generators. This arrangement makes the turbines and generators perfectly interchangeable, either turbine carrying the load of either one of the generators.

Two Westinghouse 1,000 volt, 60 cycle, two-phase alternators make up the generating equipment, the voltage being raised to 5,500 volts three-phase for transmission to Montego Bay over a bare wire line supported on square pitch pine poles.

This being the first bare wire transmission line in the British West Indies, and the Director of Public Works having asserted that iron poles were a "sine qua non," and an old set of regulations calling for continuously insulated wire, a vast amount of red tape had to be unwound before government permission could be got to run the line. The matter was submitted to the

RUINS OF OLD SUGAR WORKS EMPLOYED FOR ELECTRIC LIGHT PLANT, MONTEGO BAY, JAMAICA, W. I.

Board of Trade in London, involving a further delay of six months without any adjustment being arrived at, and all the satisfaction the company got was a request to "submit it again." The work was delayed over a year and the company nearly ruined financially in order to decide whether wooden poles and a bare wire line such as is used in all quarters of the globe was good enough for Jamaica. The matter was finally decided in the company's favor by a member of the Royal Engineer Corps. Still, the difficulties in getting through cocoanut trees on a tropical road with a bare wire line are not slight.

In Montego Bay the current is stepped down to 2,000 volts, two-phase for local distribution carrying arc and incandescent lights and a heavy motor load, the motor running an ice factory, aerated water factory, sugar centrifugals, etc. The distribution covers an area of about four square miles, the supply in the residence districts being very scattered indeed.

The plant was started about three months ago and is running very satisfactorily, the varied application of current and largely scattered distribution giving no trouble. In Jamaica the promotion of enterprises of this kind will always be hazardous owing to lack of appreciation and to the apathy of the public, who have absolutely no pride in any local improvement.

A servant sent to the creek with a gourd to get water to mix with rum is quite as good as a modern water supply, and a candle, or for that matter a few lightning bugs, are quite good enough for them to go to bed by. This feeling is by no means

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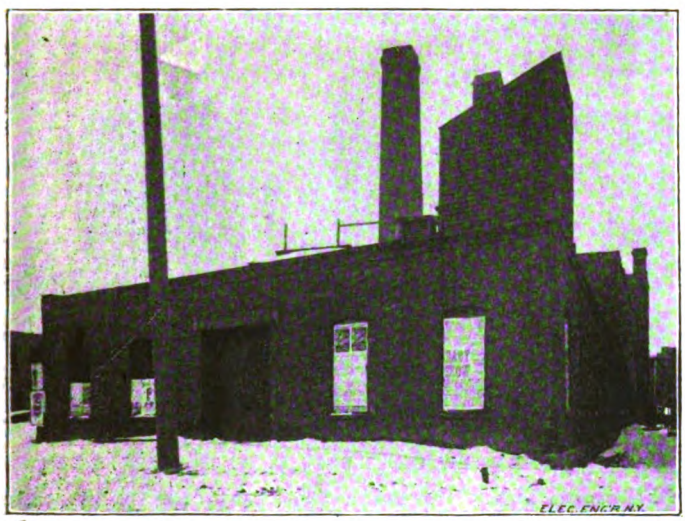
confined to the lower classes. The "Club," including in its membership the merchants and leading people in the town still has its billiard table periodically spotted by drip from kerosene lamps, and some of the town fathers have not yet survived the shock of having the streets lighted contrary to the traditions of their forebears. Still, the company gets business enough to pay a handsome interest on its investment, and there is a hope that native conservatism which is very closely allied to "mananaism," will some day be pierced by electric light and be itself electrified.

The Use of Niagara Power by the Buffalo General Electric Company.

BY ORRIN E. DUNLAP.

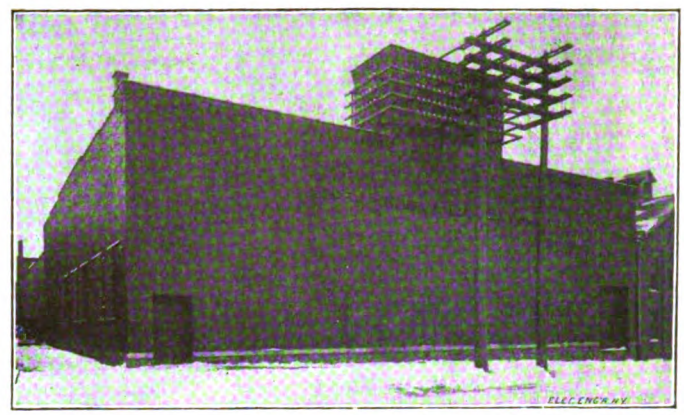
THE Buffalo General Electric Company have commenced the use of Niagara power in the station especially planned and constructed for this purpose, and thus another mile stone in the successful march of Niagara power in making Buffalo and her



THE OLD BRUSH ELECTRIC LIGHT STATION. THE FIRST ALTERNATING CURRENT CENTRAL STATION IN THE UNITED STATES.

industries captive to its benefits has been passed. The Buffalo General Electric Co. has Daniel O'Day for president; George Urban, Jr., as first vice-president; D. T. Nash is secretary-treasurer; C. R. Huntley, general manager, and Henry G. Stott is the company's engineer. It was under Mr. Stott's supervision that the apparatus in the main building was erected, and it was he who designed the building and engineered the whole plant, which is so creditable to Buffalo enterprise and so ably marks Buffalo's progress in the use of the greatest power on earth.

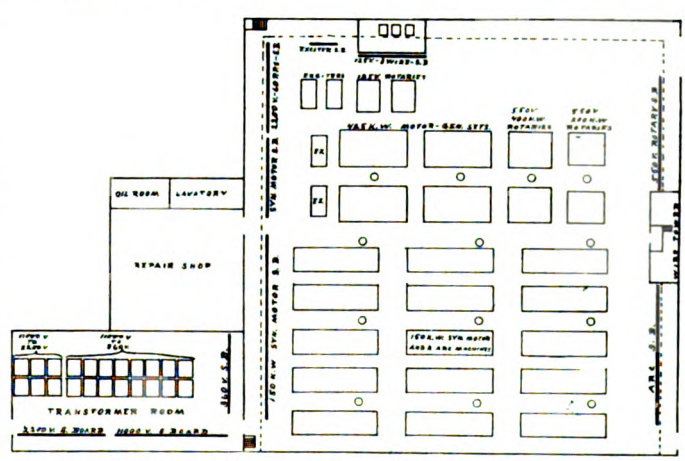
The new plant is located on Wilkeson street. Work on the buildings was commenced in March, 1898, and completed four months later. The main building is 91 feet by 91 feet 6 inches at the foundations and possesses many novel features of construction, everything about it having been planned and laid out to suit the apparatus to be installed, instead of the usual plan of designing the building first and then adapting the machinery, cables, etc., to the existing conditions. Working on these lines Mr. Stott has brought to perfection a plant which is a climax so far in his work in this country and abroad. The building is of brick, the main generator room being divided into two equal parts by a row of steel columns. These steel columns serve the double purpose of supporting steel beams for the two ten-ton cranes and the roof trusses. The steel trusses are also supported by the side walls, and resting upon them are I-beams, which in turn support inverted T-irons. On the flanges of the latter rest hollow book tiles, the latter measuring 18 by 15 by 4½ inches. Upon this, after all joints had been cemented, was poured melted asphalt and roof pitch, with a double layer of roofing felt and then more pitch, and finally gravel. The result is a very fine roof, and the steel, being protected from sudden changes of temperature, does not sweat and drip on the machinery below. Fire walls are carried four feet above the roof and the latter pitched in four directions, the water conductors being carried down inside the building to avoid trouble from freezing. The height of the main generator room below the trusses is 27 feet, and from the dome of the four large skylights



NEW STATION OF THE BUFFALO GENERAL ELECTRIC COMPANY, SHOWING WIRE TOWER.

37 feet from the floor. The skylights are 18 feet by 8 feet, and each is so arranged that any side can be opened from the floor of the generator room. One side of the generator room has a row of windows protected by iron shutters. The floors of all rooms are brick arches covered with concrete and "marbleithic" finish.

The transformer room is located in the rear of the main building. It has the same general construction as that mentioned, its dimensions being 51 feet by 25 feet 6 inches. Beneath the floor there is a brick air chamber into which motor driven fans deliver air at a pressure of about one-half ounce to cool the step-down transformers. Following the current as it comes in from the tile conduits in the manhole we are led into a cellar 7 feet 6 inches high, through which are carried the three conductor cables carrying the 11,000 volt, three-phase current from Niagara Falls. These cables rise to a loop panel which has on it six double-bladed, single throw switches. These complete the



PLAN OF STATION, BUFFALO GENERAL ELECTRIC CO.

loop in the two three-phase conductor cables and also allow either circuit to be opened at this point in case of a fault in the cable beyond the transformer station, thus affording several advantages over the ordinary taps. From this panel the current goes to the time limit circuit breakers of the shunted fuse type, which are so arranged that in the event of a short circuit in either cable—both being in multiple all the time—the reversal of current in the one will cause the circuit breakers to cut loose all apparatus in the station from the defective cable. Here it may be noted that similar arrangements are being installed in

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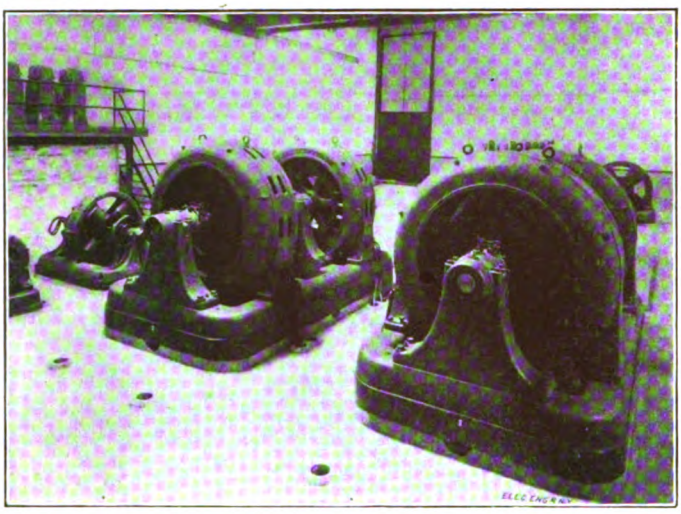
all the transformer stations of the Cataract Power & Conduit Co., so that in the event of trouble on one of the two circuits, all stations will automatically disconnect themselves from the faulty cable.

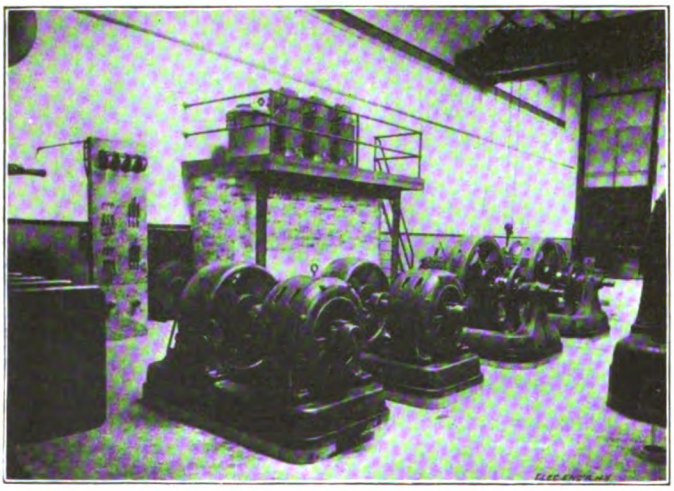
Leaving the circuit breaker panels we come to the transformer panels, four of which are installed to the left of the loop panels. Each of these panels contains six special high tension expulsion



425 K. W. SYNCHRONOUS MOTORS, D. C. TO 400 K. W. QUARTER PHASE 60-CYCLE GENERATORS.

type fuse blocks, and three high tension switches, and each panel supplies current to three 250 k. w. step-down transformers, reducing the three-phase current from 11,000 or 22,000 volts to 352 volts, three-phase. These transformers are connected in groups of three to one panel, and both primary and secondary are wired single phase to the switchboards, the delta connections being made on the panels, after passing through the fuses, thus in case of a transformer giving out, it will have both primary and secondary cut off without disturbing others in the same group.

Through an opening in the wall, under the floor, are led the cables which run from the low tension bus-bars into the main building, one group of heavy, rubber covered cables going to each switchboard in the main room, the object being to subdivide the power as much as possible, and thus reduce the chances of a short circuit, no set of cables carrying more than 1,200 h. p. In each of these groups of cables are inserted circuit breakers, which may be tripped automatically or by hand, so that in the event of trouble on one group of panels that partic-

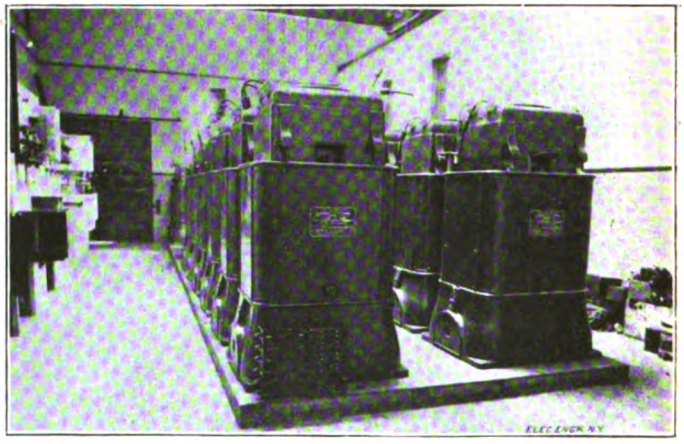


EXCITER SETS AND 125-VOLT ROTARIES, WITH TRANSFORMERS FOR THE ROTARIES, ON GALLERY.

ular group, amounting to 1,200 h. p., may be disconnected from the low tension bus-bars in the transformer house.

One of the substantial and serviceable novelties of the station is found in the subway that extends around three sides of the generating room. This subway is 6 feet high by 4 feet 6 inches wide. On the walls are placed iron shelves 3-16 inch thick and 10 inches wide, supported by angle irons built into the wall. From four to seven of these shelves are placed one above the other, thus forming a resting place for the numerous lead covered cables running to motors, generators, street circuits, etc. Connecting these subways, and running at right angles to them, are rows of tile conduit, broken by manholes, from which rise tile connections to the various motors, rotaries, generators, etc., all wires being under the floor and each circuit in an individual tile conduit. The iron shelves in the subway have breaks of 12 inches every 6 feet, and above these breaks a flue tile 8 by 14 inches rises 4 inches above the cement floor and 4 feet 6 inches from the wall, affording means of connecting the cables in the subway to the various switchboards.

The northern half of the generator room will be entirely devoted to arc apparatus, and the southerly half to alternators, three-wire rotaries and 550 volt rotaries. On the north side of this room there are at present installed six 150 k. w., 352 volt, three-phase synchronous motors, each of which is direct-connected to two No. 11. Brush, 125 light 9.6 ampere generators, these generators being fitted with the new oil type automatic regulator and a special iron-clad ammeter on the terminal board, making each machine entirely self contained. The motor drives the arc machines by means of a very simple yet efficient form of insulating flexible coupling, consisting of four arms or spiders on the motor shaft, and a similar number on the generator, each compressing rubber rolls 3½ inches in diameter and



GENERAL VIEW OF THE 250 K. W. TRANSFORMERS.

4¾ inches long. This forms what has proved to be a most serviceable coupling.

All the switchboards in the generator room are of blue Vermont marble. Each panel is 30 by 100 by 2 inches, the motor board being at one end of the room, and the generator board at the opposite end, each standing out 4 feet 6 inches from the walls and directly in front of the tiles opening into the subways. The rows of conduits already mentioned run down every alternate aisle.

The synchronous motors are started through reacting coils fastened on slate bases and to the walls directly behind the panels connected to them. Three single pole, double-throw switches, when down, turn current into the stationary armatures after passing through the reactances and thus keeping down the starting current to 150 per cent. of the full load current. The three-phase currents in the stationary armature induce secondary currents in the revolving field pole faces, and thus develop about one-quarter full load torque, which is sufficient to bring the motors up to full synchronous speed in about 70 seconds, when the 110 volt exciting current is thrown into the fields and the proper adjustment made with the field rheostat for minimum current in the armature, after which the single pole switches are thrown up, one at a time, the motor meanwhile running single-phase, thus cutting out the reactances entirely. The full load efficiency of the motor is 94 per cent. In the construction of the plant foundations have been put down for 15 sets, each set having a capacity of 250-2,000 c. p. arc lamps, thus giving a total capacity of 3,750 arc lamps. In the meantime, however, developments on the long promised rectifier are being closely watched, and, if successful, will be used in place of more motor generator sets, owing to the increased efficiency and de-

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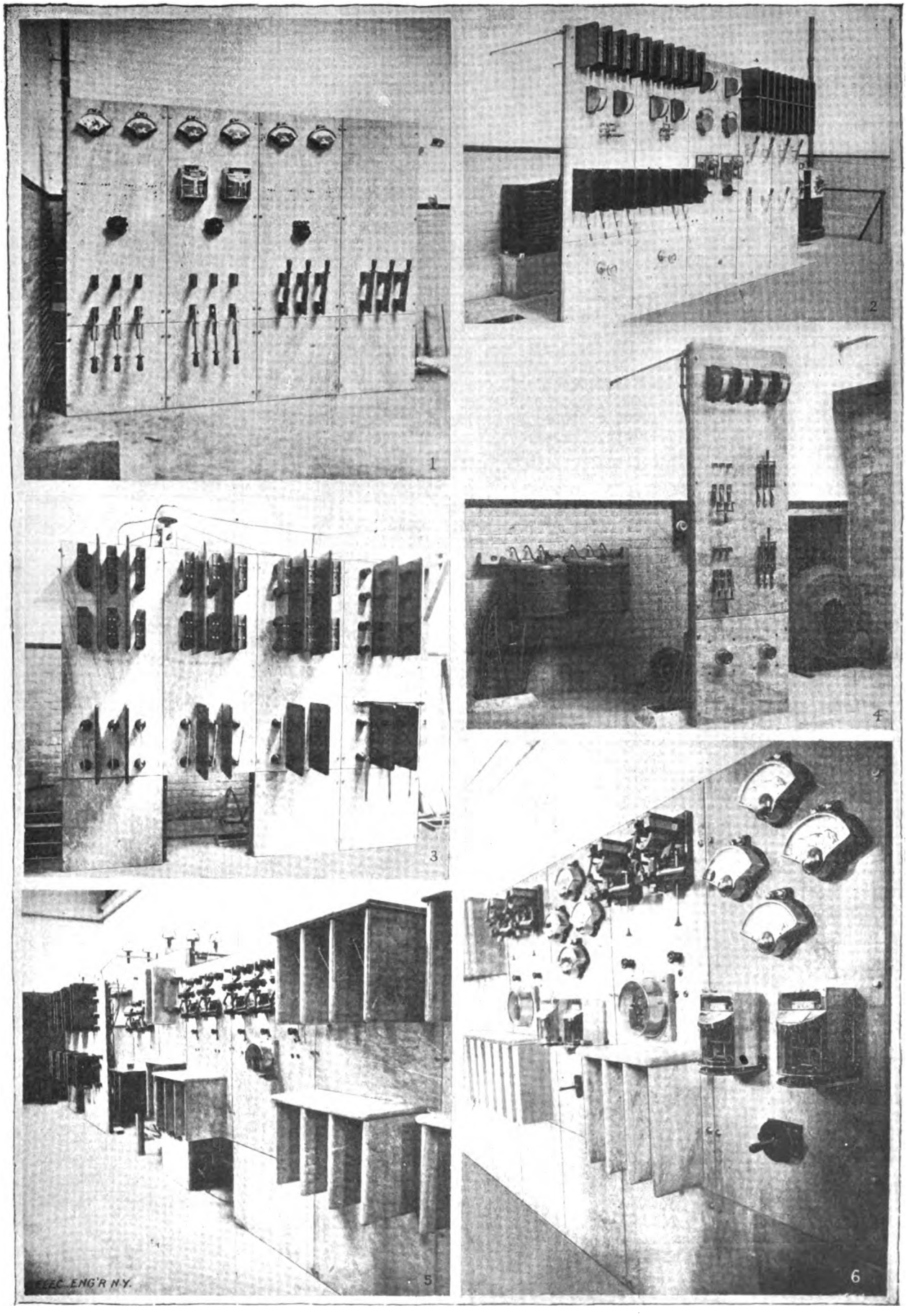

GROUP OF SWITCHBOARDS IN NIAGARA POWER STATION OF BUFFALO GENERAL ELECTRIC COMPANY.

1—Secondary switchboard of Cataract Power and Conduit Co. 2—The 2,200 volt 60 cycle quarter-phase switchboard. 3—Primary switchboard controlling twelve 250 k. w. transformers. 4—Exciter panel with starting compensators in the rear for induction motors. 5—The 11,000 volt three-phase loop and circuit breaker panels. 6—The 2,200 volt, three-phase 25 cycle line and instrument panels.

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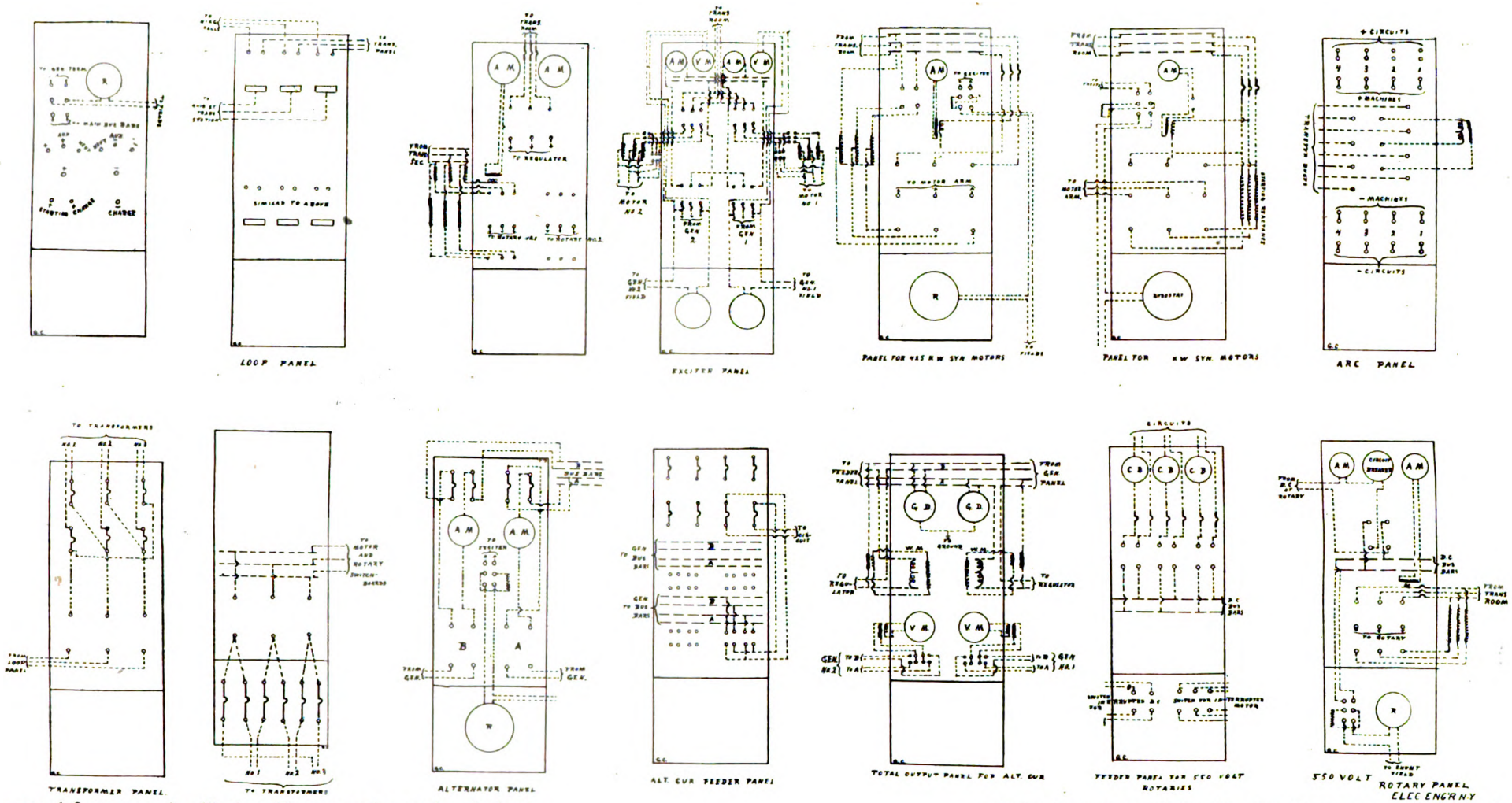

DIAGRAMS OF SWITCHBOARD CONNECTIONS IN STATION OF BUFFALO GENERAL ELECTRIC CO. FOR THE SUPPLY AND CONTROL OF NIAGARA POWER.

creased floor space it will give. To summarize results obtained in this station, it may be stated that the Buffalo General Electric Co. get motors, generators and switchboards in a space of 1 1-10 square foot per arc lamp.

In the southerly half of the generator room are two exciter sets, consisting of a 30 h. p. induction motor, direct connected to a 20 k. w., 125 volt, direct connected generator, each of these exciter sets being capable of furnishing the entire exciting current to the synchronous motors. These motors are started through compensators fastened to the wall behind the switchboard controlling the exciter sets. Next to these are the two large motor generator sets, consisting of a 425 k. w., three-phase, synchronous motor, direct connected to a 400 k. w., two-phase, 60 cycle generator, both motor and generator being of the revolving field type, the latter giving off in two independent circuits having a phase relationship of 90 degrees apart, a 2,200 volt, 62½ cycle current. As the motors have eight poles and the generators 20, it is evident that in synchronizing the two generators there are several possible phase relationships, all depending on which pole "locks" in the two motors. The phases in the quarter phase generators may be 18 degrees apart or any one of five or six possible combinations. To overcome this a synchronizing voltmeter is connected between the two generators, and when one is running and the second one is being brought up to speed, the field is thrown into the generator, and when the synchronizing voltmeter shows zero, the field of the motor is closed, thus locking the motor at the proper place.

The switchboard arrangements for these large motors are identical to those for the 150 k. w. motors, with the addition of one double pole single-throw switch, which controls two of the

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primaries of the two to one ratio compensator, this being cut out entirely by throwing up the three single pole double-throw switches.

The switchboard for the 60 cycle generators consists of two generator panels, two feeder panels, and one total output panel, with the necessary instruments. In the bus-bars of each phase are connected two potential regulators of the C. R. type, giving a four per cent. boost or lower with one-fourth of one per cent. steps in order to balance up the phase if necessary. The efficiency of the 425 k. w. motor is 96.5 per cent., and of the 400 k. w. generator, 96 per cent. with a regulation of 7 per cent.

Two 100 k. w., 125 volt rotaries have been installed in order to

VIEW OF 150 K. W. SYNCHRONOUS MOTORS D. C. TO BRUSH ARC MACHINES.

make a start with the new three-wire Edison system, mainly as an experiment, in order to determine whether the regulation will be good enough on the power circuits, and also for charging up a large battery of storage cells which it is contemplated to install in the near future. These rotaries have induction regulators in the primaries of the three static transformers, reducing from 352 volts, three-phase, to 80 volts, three-phase, thus enabling a boost or lower of 10 per cent. to be given. Reactances are also permanently connected in the loads of each rotary, thus permitting a large variation in the voltage of each rotary by varying the field excitation and thus the phase relationship of current and e. m. f. The front of the gallery on which are located the transformers will be taken up by the three-wire system switchboard.

There are two 200 k. w., 550 volt rotaries which supply power to a very healthy business in 550 volt motors, running elevators, machine shops, etc. Provision has been made in this line for an increase of four times the present capacity, as this is believed to be the probable result, within a year or two, of the application of cheap Niagara power in Buffalo. These rotaries are started through reactances in exactly the same manner as the synchronous motors, a special switch being mounted on the frame, which opens the circuit between each of the field poles, thus breaking up the high potential induced from the armature in starting. The panels of the switchboards controlling these rotaries are similar in design, so far as possible, in order to simplify operation.

The wire tower is well portrayed in the illustration. It is entirely fireproof in construction, and contains only lead covered cables on insulators, separated four inches, and the lightning arresters mounted on an iron framework away from the cables.

At one side of the transformer room is the repair shop, which is about 25 feet by 26 feet in size. Opening off from it is the locker room for employés' clothes. In the rear, and opening only on a court, is the oil room, which is so constructed with fire walls that in the event of fire nothing would burn except the oil; the walls being of brick would simply form a chimney and prevent any possibility of the fire spreading.

The transformers and switchboards in the transformer house are the property of the Cataract Power & Conduit Co., the distributing agents of Niagara power in Buffalo. This company has also a separate group of transformers, reducing the Niagara current to 2,200 volts, three-phase, for distribution to large power consumers, among whom will be the Urban flour mills, which will use about 500 h. p.

All the transformers, switchboards, motors, generators, etc., were furnished by the General Electric Co., of Schenectady. There is a total of 5,600 h. p. in transformers; 3,300 h. p. in motors and rotaries, and 2,160 h. p. in generators, together with the necessary switchboards and regulating apparatus, all forming a very handsome order of over 11,000 h. p. in complete equipment.

As stated, all the apparatus in the main building was erected and installed under the personal supervision of Mr. H. G. Stott, the engineer of the Buffalo General Electric Co., while the switchboards belonging to the Cataract Power & Conduit Co., were erected and wired by Mr. I. R. Edmands, of the General Electric Co.

The Buffalo General Electric Co. is the only company in Buffalo supplying electricity for lighting purposes, and the perfection which apparently has now been obtained in their facilities is the result of having men of force and financial strength at its head. The company was formed in the summer of 1893 by the consolidation of three companies, viz., the Brush Electric Light Co., the Thomson-Houston Electric Co., and the United States Electric Light Co. At that time the Brush Co. was operating two plants, one on Elk street, for city lighting, and one on Wilkeson and Seventh streets, for incandescent (alternating) and commercial arc lighting. The total output of this company at the time of the consolidation was about 1,000 h. p. The Thomson-Houston Co. had one plant on Court street, near Pearl, and had a total output of city and commercial lighting, including a small 500 volt power service, of about 600 h. p. The United States Co. had a plant in the northern part of the city, in the Black Rock district, with a total output of about 300 h. p., chiefly city lighting. A year after the consolidation of these companies, the Elk street and the Court street stations were the only plants running in the city, the business having been consolidated into these two stations with the usual good effects following concentration, viz., reduction of operating expenses and increased efficiency.

Within about a year of the consolidation the company suffered the complete loss by fire of all its electrical apparatus in both stations. However, the men interested were undaunted, and it is highly probable that the electrical fraternity will remember that the ashes of the fire were not cold before new machines were running in place of the old, the interruption, in either case, being not more than 36 hours. Special trains of apparatus were dis-

VIEW OF SUBWAY, SHOWING THE IRON SHELVES.

patched from all of the factories of the General Electric Co. and Brush Co., then in Cleveland.

By the summer of 1895 the business of both city and commercial lighting had increased so steadily that numerous additions were made to both plants, including the taking out of small units and replacing with large. After numerous annexes had been built, or until there positively was no further room for expansion, the directors of the company had to face the problem of a new station on a new site, and with it the question of consoli-

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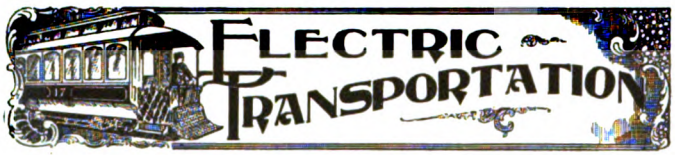
dating the two stations. This was in 1896. At this juncture still another problem presented itself for solution, and this was the power development of the Niagara Falls Power Co., at Niagara Falls, and the probable effect, efficiency and success of the transmission of this Niagara power to Buffalo. The question was, should the new station be operated by steam or by electricity transmitted from the Falls. After mature deliberation, the latter form of energy was decided on as being best suited to all the requirements of the situation. The site selected for the new station was beside the old Wilkeson street plant. This was owing to the fact that the company already owned this property, upon which stood old buildings. The lot has a frontage of 94 feet on Seventh street, and runs back to State street 220 feet, so that, with the old buildings covering an area of over 9,000 square feet, there was no danger of being crowded out. Here side by side stand the two stations, the one being the first alternating current station in the United States, the other the perfect modern development of a progressive company.

It may be added that the reason for the adoption of the 352 volt standard secondary pressure, at which current is received from the Cataract Power & Conduit Co., was that this pressure is suitable for use in 550 volt rotary converters without further transformation, and at the same time is a safe pressure and one easily handled with revolving field type motors, in which all the small direct current is carried in the revolving part.

The wire tower of the old station is to be seen on the corner and was in use up to about six years ago. As compared with the new wire tower it is typical of the progress made in that period.



Campbell Surface Contact System of Electric Traction.

IN view of the growing interest in surface contact or closed conduit electric traction systems, and the great hopes which they hold out for a final solution of this much-discussed and difficult problem, we are glad of the opportunity to illustrate a system invented by Mr. Geo. L. Campbell, of Dushore, Pa. It has been tried experimentally and submitted to the judgment of experts and practical street railway men, and the unanimous opinion seems to be that the system is simple, practical and economical, and possesses important advantages in regard to magnetic or "third-rail" systems. Its distinctive feature and chief merit lie in the fact that its working parts are so few and so solidly constructed that the chances for accident are reduced to a minimum.

The conduit of this system, shown in longitudinal and vertical cross-sections in Figs. 1 and 2, is a continuous body (air and water-tight), about 6x9 inches in cross-section, and which rests on top of the ties and does not project above the rails on which the cars run. It requires absolutely no excavation of the earth to install the system—an advantage that will be instantly appreciated by all practical street railway men, as it lessens both the cost and trouble by more than two-thirds.

The bottom and sides of the conduit may be of either wood or iron as preferred, while the top in either case consists of from 4 to 8 foot metal sections—thoroughly insulated from the rest of the conduit and from each other. The interior of the conduit is hollow, and at the bottom on the inside lies a continuous rail carrying a 550 volt current. There can be contact between this rail and the top of the conduit only by means of a specially designed trolley or traveler that runs in the conduit, and is controlled in its movements by a pair of strong electro-magnets on the car.

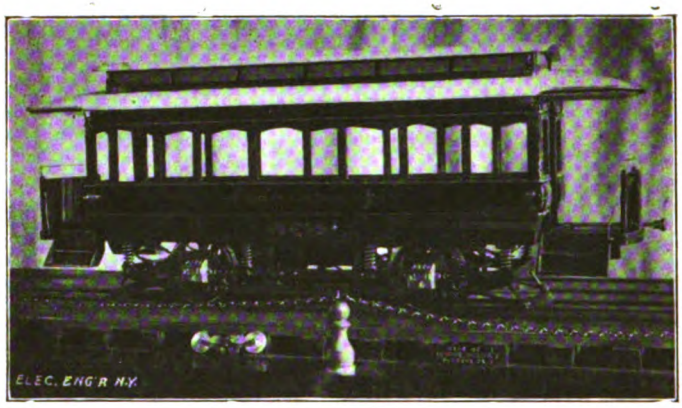
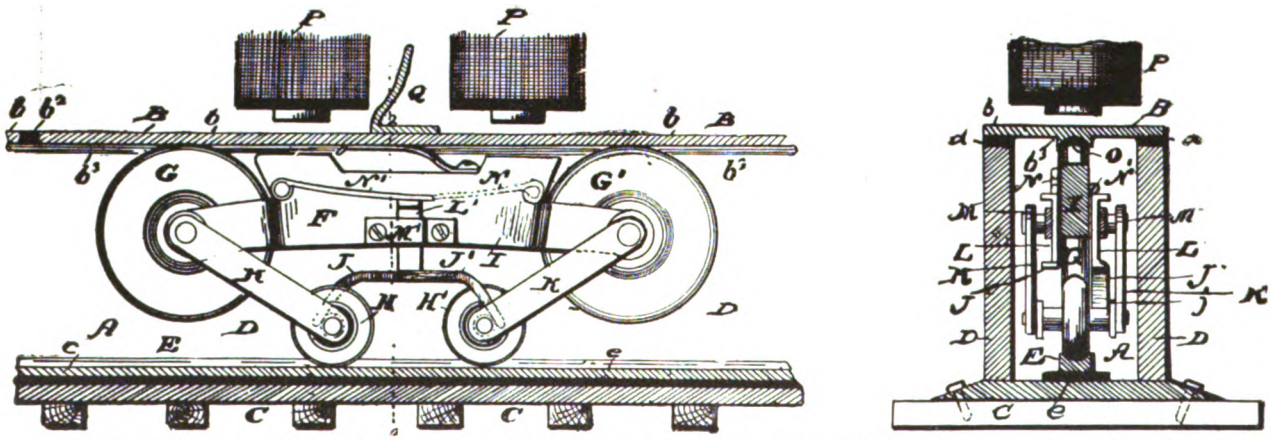


FIG. 3.—CAR OF CAMPBELL SURFACE CONTACT SYSTEM.

This trolley carries the electric current from the lower conducting rail, E, inside the conduit, to the top sections of the conduit, B; there it is taken up by a metal shoe, Q, suspended from the car and pressing down on top of the conduit. The current passes up from the shoe to the motor and returns by the side rails, or by passing down another shoe and returning by means of a double trolley, thus completing a "metallic circuit."

As the car moves along by the current thus conveyed to the motor, a large pair of electro-magnets, P, suspended from the bottom of the car, act through the metal top of the conduit and hold the trolley inside the conduit just the same as if an iron rod connected the two parts, with the result that the trolley travels at the same rate as the car above it, and always holds its position under the magnets at the centre of the car. As a consequence it appears impossible to get a shock from this system without getting under the car, as the conduit is always "dead" outside of the car and "alive" for only a few feet directly under the car, no matter where the car may be.



FIGS. 1 AND 2.—LONGITUDINAL AND VERTICAL CROSS-SECTIONS OF CAMPBELL SURFACE CONTACT SYSTEM.

Fig. 2, as shown above, is simply a conventional diagram of cross-section of conduit; in actual practice the conduit is almost entirely surrounded by cement and concrete to any desired extent, so that it is impossible for any water to leak into the con-

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duit. At the same time the cement offers a high resistance, being an absolute safeguard against leakage of current.

Switching is easily accomplished by this system as the traveler is bound to obey both the lateral and forward pull of the magnets.

Having reference to Figs. 1 and 2, E is the lower rail, insulated from the ties C by the strip c. Against this rail the wheels, H, H^1 are continually pressing, and are in mechanical contact with the larger wheels, G G^1, by means of the connecting strips, K K and F, aided by the spring, N^1, which keeps the large wheels in contact with the upper rail, B. Electrical contact is made by means of the brushes, J J^1, held in position by the clamp, M^1. The frame, I, is made of iron and when this is attracted by the magnets, P, P, on the car, the electrical circuit is completed between the upper and lower rails.

The advantages claimed for the Campbell system may be summed up as follows:

1. A simple and solidly constructed conduit, resting on the ties and requiring no excavation, and one that can be cheaply put down, and once down will not be in need of repairs for years. It will stand any weight which is liable to be placed upon it, and insures good and lasting insulation.

2. Few and simple working parts, thereby reducing cost and risk of accidents. A trolley built up of solid aluminum castings (depending on no springs for its perfect action), a pair of electro-magnets and a solid metal shoe for collecting the current, completes the entire equipment.

3. The Campbell system is a surface contact enclosed conduit system, and has no slot or opening whatever in the conduit by which it can become filled up with dirt or water.

4. Snow, ice or water flooded tracks cannot interfere with the perfect working of this system, or cause any cross or ground connections.

Possibly the most noteworthy claim of this system is the fact that while other magnetic systems depend on making a working contact for each sectional conduit through separate switches—some of which work well while others fail—the Campbell system has always the same solid, perfect and sparkless contact for each section. In addition, the magnetic switch systems are of necessity delicate and require accurate adjustment, while the trolley of this system is solid, substantial and built to stand hard work.

In a series of experiments carried out to demonstrate the reliability of the system, it was found to be impossible so long as a steady current was flowing through the magnets to "lose" the traveler, in spite of the great air space separating it from the magnets, even when the car was struck back with a force, equal, in proportion, to a head on collision between two large cars. In case of the main circuit breaking, an auxiliary current furnished by a few cells of storage batteries is automatically cut in and holds the traveler in position until the main circuit is again cut in when the cells are cut out.

The Campbell system is thoroughly protected by United States and foreign patents, some granted and some now in the patent office, and while the above article gives a general idea of the system, it does not show the many details that have been worked out to meet the requirements of actual service and now form the basis of a number of pending patents,. The Campbell Electric Traction Co., Towanda, Pa., invite all interested parties to inspect the system.

An American Trolley Road for Porto Rico.

The San Juan and Rio Piedras Railroad Company has been incorporated at Albany, with a capital of $300,000, to construct and operate an electric or steam railroad seven and a half miles long from San Juan to Rio Piedras, Porto Rico. George H. Walbridge, Fernando G. Echeverria, H. H. Harrison, Edward Schmidt, Lathrop R. Bacon, F. Kingsbury Curtis, Philip H. McMillan, Augustin N. Hand and William B. Parsons, of New York City, are the directors.

J. G. White & Co., No. 29 Broadway, who head the syndicate incorporated as the San Juan and Rio Piedras Railroad Company, said that the corporation was formed to enlarge and improve the service of a railway already existing between San Juan and Rio Piedras, which was bought from Pablo Vbarri, a Porto Rican millionaire, a month ago. It has been in operation by them ever since. It is their intention to change the motive power to electricity, widen the gauge and improve the rolling stock. They will make the service half hourly, instead of hourly, as at present.

Gains in Trolley Road Earnings.

Recent reports as to improvement in trolley earnings are as follows: In New York City the Metropolitan Street Railway Co. shows 24.8 per cent. gain in the last nine months of the year; in Brooklyn the Brooklyn Rapid Transit system shows 12.8 per cent. gain, and the Nassau system, 14.2, while the elevated lines in that city have to record a loss. In Albany the gain is 8.6 per cent.; in Syracuse, 5.9 per cent.; in Providence, 2.8 per cent.; in Boston (North Shore Traction Co.), 3.6 per cent.; in the shoe manufacturing city of Brookline, 1.3 per cent.; in Baltimore (Consolidated system), 1.6 per cent.; in Scranton, 6.1 per cent.; in Cleveland (Cleveland Electric), 5.1 per cent.; in Columbus, 12.8 per cent.; in Detroit (Detroit Citizens'), 8.4 per cent.; in Chicago (North Chicago), 3.9 per cent.; in Minneapolis (St. Paul), 8 per cent.; in New Orleans (New Orleans Traction), 5.6 per cent.; in Kansas City, 1.07 per cent., and in Denver, 4 per cent.

Trolley Expressage Abandoned at Hartford, Conn.

An interesting experiment in a trolley express service has been made on a road running from Hartford, Conn., to some neighboring villages, but abandoned after a trial of three days. The scheme was to facilitate the delivery in remote districts of goods bought in the Hartford stores. City merchants arranged with the trolley company to carry the packages, and provided wagons to meet the cars in the villages, and thence transport the goods to the homes of the purchasers, without charge to the latter. The arrangement worked to the satisfaction of the merchants and their country patrons, and would have been continued but for the pressure brought to bear on the railroad company by the village storekeepers. These asserted that the effect on their business during the three days that the express-car was run was demoralizing. The president of the trolley company conceded that the first business of the railroad was to carry passengers, and he withdrew the car. He would appear to have been more considerate of the country shopkeepers than of his own railroad, as the express-delivery arrangement might be expected to increase the passenger traffic.

American Automobiles for Abroad.

A special dispatch from Chicago, of Dec. 29, says: Count de Jotemps of Paris, France, has closed a contract for the purchase of about $5,000,000 worth of motor vehicles of Chicago manufacture. The Count is president of the American General Agency, with headquarters at Paris, and office in every capital in Europe. The aim of this company, it is said, is to control the European agency for the sale of American-manufactured motor-vehicles.

The contract which Count de Jotemps closed was with the Fischer Equipment Company of Chicago, and under it the company agrees to furnish the agency with 250 electric vehicles a year for the next five years. These vehicles include carriages and wagons of every description, and are known as the Woods motor-vehicles, the motive power of which is electricity. The first instalment of vehicles is to be delivered in Paris not later than March 15, and soon after that date they will be placed on sale in every town of importance in Europe.

The Count has also closed contracts with the Holyoke Motor Company of Holyoke, Mass., manufacturers of a gasoline motor carriage; the Overman Wheel Company of Chicopee Falls, Mass., manufacturers of light gasoline motor carriages, and the Stanley Automatic Carriage Company of Newton, Mass., which makes a steam motor carriage. The combined contracts call for 1,500 vehicles to be delivered each year for the next ten years. The aggregate price to be paid is said to fall not far short of $15,000,000.

"The American patents on horseless vehicles are the only ones of practical value on the market," said the Count. "In Europe we have nothing that can compare with the American motor vehicles, either in lightness, easy-running qualities, rigidity, or stability. We are satisfied that America will furnish the horseless carriage of the future, and it is our idea to control the supply."

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Among the stockholders in the Paris company is Albert Geiger, a Boston capitalist. Count de Jotemps married a Mrs. Bennett, of New Haven, Conn., several years ago, and with his bride acquired an immense fortune. He says that his company will open its Paris offices on the Champs Elysées on March 15, and will soon establish branches in London, Berlin, Vienna and Brussels. His company has a capital of $2,000,000. The first shipment of vehicles from Chicago will be made in January.

Thirty Trolley Men Divide $16,000.

A special dispatch from Newport News, Va., of Dec. 26, says: Thirty employees of the Newport News & Old Point Railway & Electric Company, formerly the Newport News, Hampton & Old Point Railway Company, divided $16,000 between them to-day, the gift of J. S. Darling, president of the old company, and his son. Individual amounts were based on time of service. One man received a check for $1,000, and several conductors received $750 each. The money was the accumulation for seven years of fares paid in by conductors, but not rung up on the registers.

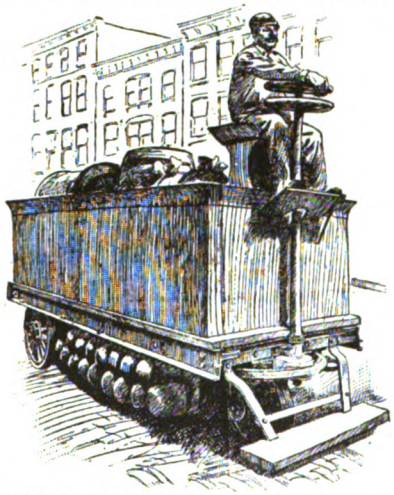
A Swedish Submarine Boat.

King Oscar gave an audience on Dec. 23 at Stockholm to Engineer Orlings, who explained to him the details of his invention in the shape of an electric submarine torpedo boat, which it is possible to control from a distance. The King showed deep interest in the plan of Mr. Orlings, in accordance with which the boat is to be built at once and given an early trial.

Plans of the New York Autotruck Co.

AUTOTRUCKS for use by the New York Autotruck Company, are now being constructed by the American Wheelock Engine Company, of Worcester, Mass., and will, it is promised, soon be seen in the streets of this city. Platform trucks for carrying heavy machinery and trucks with high boxes for coal, ice or other commodities, will be first used. Compressed air will furnish the motive power.

Motormen who operate these trucks will have a high seat



COMPRESSED AIR TRUCK FOR NEW YORK CITY.

forward, with a double wheel similar to the arrangement on a cable car for controlling the power. One wheel will be for steering purposes, and the other will open or close a valve between the air chambers and the motor. Although these trucks will have a carrying capacity of eight tons and can be run on smooth pavements as fast as eight miles an hour, it is asserted that they can be stopped in their own length. By shutting off the air the wheels are locked and the truck comes to a sudden standstill. The trucks are built with wide tires, so that asphalt or macadam roads will not be injured by them.

Property for the site of a power house has been purchased in this city, and a plant costing $250,000 is to be erected for the initial operations. The Wheelock Company, of which Edwin S. Cramp, of Philadelphia, is president, has completed the first air compressor for the New York power house of the Autotruck Company. James H. Hoadley, president of the Compressed Air Power Company, of 253 Broadway, who is largely interested in the Autotruck Company says: "The International Air Power Company, a $7,000,000 corporation, in which Mr. Joseph Leiter is largely interested, is being organized. Mr. Leiter will not be president. He will probably be one of the directors. This company will be incorporated in New Jersey. An existing plant has been bought by Mr. Leiter for $3,000,000, and it will be in operation within sixty days. Mr. Leiter has interested the Rothschilds and other European capitalists in the introduction of autotrucks in foreign cities. They will be manufactured in this country and will be first operated in London. Later they will be introduced in Berlin and Paris."

The Mammoth Generating Plant of the Third Avenue Railroad Co., New York City.

IT has now been officially confirmed that the contracts for the equipment of the Third Avenue Railroad Company's power house have been placed. Some of the larger contracts were closed last week. The contract was awarded to the Westinghouse Electric & Mfg. Company, which included the contract for the power plant to be furnished by Westinghouse, Church, Kerr & Co. of 26 Cortlandt street, this city. This power house will be the largest ever projected, consisting of 16 units of 3,000 kilowatts each. The power station which the Metropolitan Street Railway Company are now equipping consists of 11 units of 3,000 kilowatts each.

The Third Avenue Company's station will be built on a site which they own between 216th and 218th streets and between Ninth avenue and the Harlem River. The Westinghouse, Church, Kerr & Co. are also appointed engineers and architects for the building and will furnish complete plans and specifications by which the contract will be let to some building contractor.

The total amount of the contract, exclusive of the buildings and substructures, is about $5,000,000. More than one-half of this sum will be expended in the equipment of the steam plant. It is stated that the thoroughness of the engineering scheme went a great way toward the securing of the contract. These plans were formulated by the Westinghouse, Church, Kerr & Co., under the specifications of Dr. Louis Duncan, chief engineer of the Third Avenue Railroad, and turned over to the Westinghouse Electric & Mfg. Company, who submitted them and included them in the general bid, which was for everything in the equipment, inclusive of the electrical apparatus.

Each of the 3,000 k. w. a. c. generators will be driven by an engine which will be built by the Westinghouse Machine Co. These engines will each have an economic rating of 4,000 h. p. This will give the station the nominal rating of 64,000 h. p., or a maximum capacity of about 100,000 h. p. The engines will stand in double rows the entire length of the engine room, which is to be 320 feet long. The boiler house, standing parallel to the engine house, will contain double rows of boilers arranged in two decks. There will be an enormous coal bin erected above the boilers, and from this the coal will chute direct into Roney automatic stoking machines. The ashes will be automatically drawn out of the hopper bottoms of the boilers. The boiler plant will be supplied with economizers, and the draft will be handled by a combination of both natural and mechanical forces on a system more complete than has ever yet been installed. Four tall stacks will be employed. Last week the contract was closed with the Babcock & Wilcox Co., for 30,000 h. p. of boilers to be in twin groups of slightly over 1,000 h. p. per pair.

The condensing apparatus will be concentrated into a central plant by which the engines will be served in sections, with special provision for handling this part of the service with economy and reliability.

There will be a separate isolated lighting plant for the buildings and adjacent premises, fire protection, cooling system, oiling system, coal and ash conveying systems and other appurtenances essential to so large a project. The main power house will be 320 feet long by 250 feet wide. The Westinghouse Electric & Mfg. Co. will also furnish the car equipments. The entire Third avenue system, which includes about 100 miles of track, will be converted into an underground trolley system, with the exception of the suburban lines. The Third Avenue Co. has, however, recently acquired the Fifth avenue stage line and is to furnish its automobiles with current from its surplus. Dr. Louis Duncan, who drew the railroad specifications, is also consulting engineer on the automobile proposition. The power house designs are shown on page 25.

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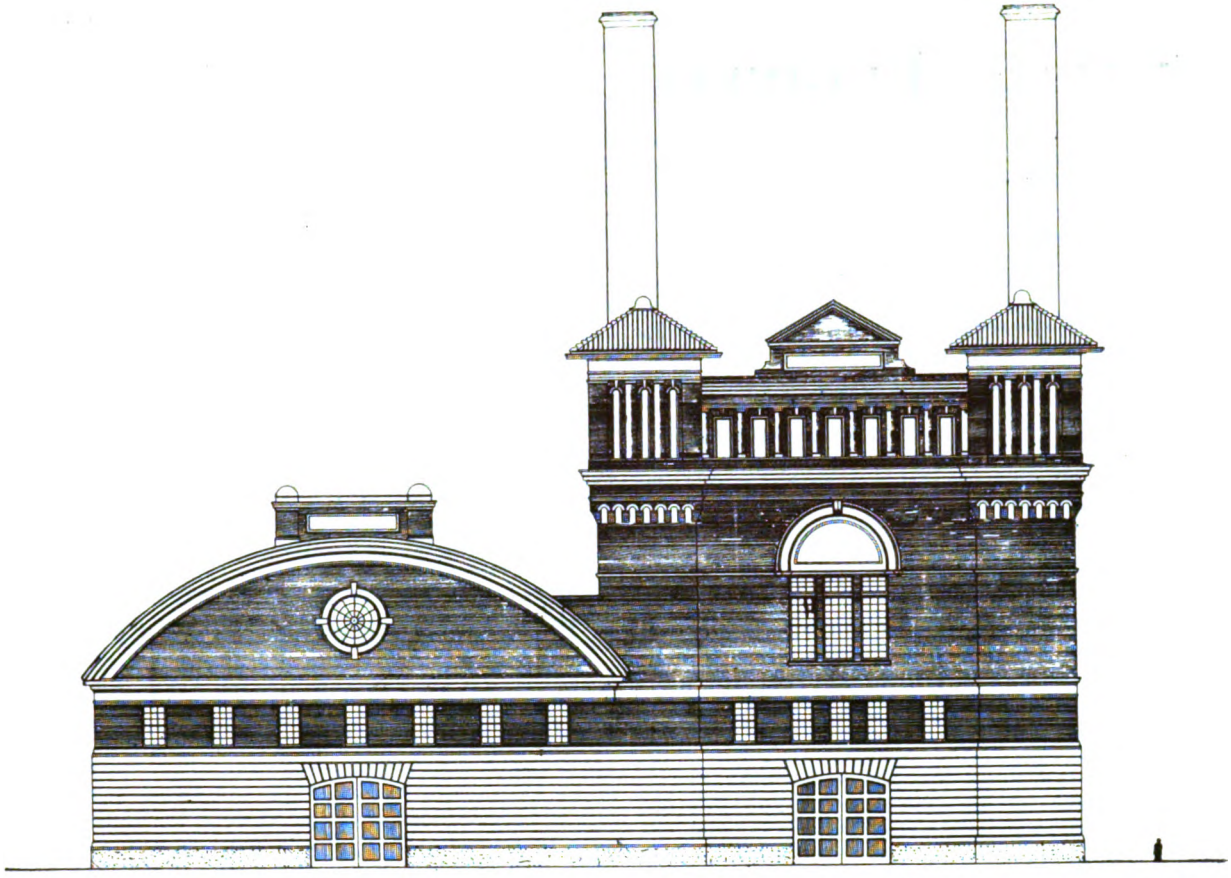
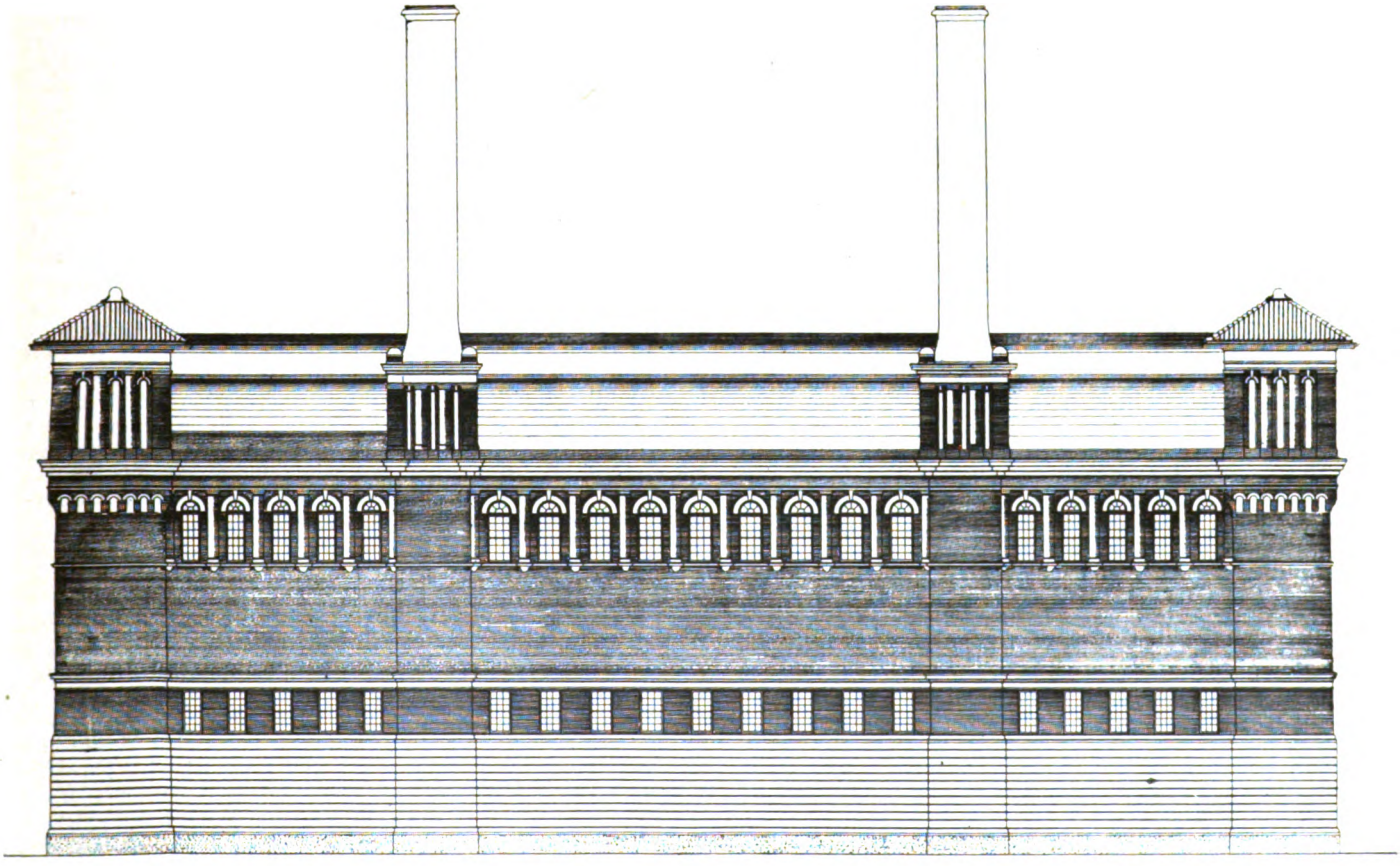


FRONT ELEVATION OF PROPOSED POWER HOUSE FOR THIRD AVENUE RAILROAD, NEW YORK CITY.
(Small black figure on right is a man, to give an idea of the proportions.)



SIDE ELEVATION OF PROPOSED POWER HOUSE FOR THIRD AVENUE ROAD.
Dr. Louis Duncan, Consulting Engineer. Westinghouse, Church, Kerr & Co., Engineers.

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THE

ELECTRICAL ENGINEER

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1898—1899.

THE year that has just closed has been remarkable in the electrical field chiefly for the revival and recuperation of industries already established, both in manufacturing and in local distribution. The long depression and even paralysis beginning in 1893 has worn itself out, the wrecks have disappeared, and the clouds that lowered have drawn down into the deeps of oblivion. The process of resuscitation began before 1898, but that year witnessed the demonstration of its effects; and very notable they were. The two chief results were the reorganization of the General Electric Co. and the consolidation of the Westinghouse and Walker interests. Financially considered, these were both decided changes for the better. How far they may operate in restraint of kindred development by other concerns remains to be seen. The period of general expansion we are now entering upon may make such vast combinations seem relatively small; just as the outburst of independent telephony has already carried the figures of telephonic growth to a point that makes the earlier Bell statistics relatively and actually insignificant. There is going to be great growth from without as well as from within.

As to local lighting and street railway companies, they, too, almost without exception, have enjoyed a year of betterment. The typical instances may be taken from New York, where the local Edison Illuminating Co. and the Metropolitan Street Railway Co. head the whole long Wall Street list—with one speculative exception—as to net gains for the year. The first of these electricals went up over $70 per share in the year and the other over $60. Both are fully worth it. The increment in the year in the value of New York Edison is $6,000,000, and in the case of the Metropolitan $24,800,000! So much for electricity and good management. The investor who neglects good local electricals is losing his chance these days.

Turning to the field of electrical discovery and invention, it may be said that there has undoubtedly been gain and improvement; but so far as actual, genuine novelty was concerned, the year offered a barmecide feast. It might have been expected that the war would stimulate the production of electrical advances, but it did not. On the contrary, it showed that some of them cannot yet be regarded as thoroughly worked out, and there was an amazing lack of use of things that ought to have been very serviceable. For example, so far as we can ascertain, not a single trial was made of wireless telegraphy. We cannot recall one solitary great new thing that belongs distinctively to 1898 and that cannot be found in the records of some previous year, and when we say this we do not overlook the curious fancies that keep coming from a schoolmaster somewhere in the eastern shadow of the Austro-Hungarian Empire. Indeed, we are constrained by the facts to say that the times are far spent for suggesting real novelty. In electricity, the nineteenth century has made wonderful records, but its utilization of unworked knowledge must stamp it as having given us in concrete form the glowing ideas that have emanated from saint and philosopher these ages past. For every concrete electrical gift to the world now, delvers in the literature of the science and art can readily find anticipations and adumbrations. When all is said and done, the world benefits by and applauds utilities, and among these, for the closing century, range the telegraph, the dynamo, the telephone, the motor, the electric light and the trolley.

Thus it is from these utilities that our export trade has grown by leaps and bounds. We go out to the four quarters of the earth, arms laden with tangible benefits to life, health, property and the pursuit of happiness, in the shape of dynamos, motors, lamps, telephones, keys and sounders, electro-medical apparatus, and what not, and there is a ready welcome for it all. As we indicated recently, these exports, for September and October, were more than double last year, and our latest figures for two weeks in December showed exports of leading lines of goods to thirty-two countries and ports to the amount of $71,000. Evidently there are large and extended markets for our electrical goods, with every possibility of developing new ones in 1899.

The Peoples Light and Power Company, of New Jersey.

ELSEWHERE in this issue we present to our readers a very full description of one of the most successful and instructive central station enterprises in this country, and one from which many valuable lessons can be learned. We have reference to the work of the Peoples Light and Power Co., of New Jersey, a corporation furnishing current for light, power and other purposes over an extensive territory with a population of about 600,000, which is constantly increasing. The growth of this company is remarkable for the reason that new property and customers were acquired from time to time by entering the field of supply on a competitive basis, furnishing current at a lower rate and then purchasing the opposition company and equipping their station with improved apparatus. Not only did they by this method prevent other companies from furnishing current, but their vigilance and low rates also induced every municipality wanting current to purchase it from them. Besides, not a dozen isolated plants are to be found in that entire territory. Another feature brought out prominently is the increasing motor load from year to year, necessitating the installation of a number of generators to supply current for power only.

Our readers will also admire the phenomenally rapid work done after the fire in starting up a nearly totally demolished plant three days after the catastrophe and the desire of the company to meet its contract obligations to the city of Newark. Actions such as these ensure for a company the confidence of a municipality; and reciprocity and a harmonious relation are sure to result. Concentration of generating apparatus is also evidenced by the building of one large station near the river front and the abolition of several small sub-stations which never could be operated at an even moderately high efficiency. The aggressive, broad-minded and progressive spirit of this young but powerful company promises a bright and prosperous future, which will be well earned and highly gratifying to their numerous friends, stockholders and supporters.

A Word About Export Trade.

A LARGE number of foreign readers have always been on the subscription lists of The Electrical Engineer, and there are more now than ever. This issue of the journal will, however, reach some who do not see it regularly or who have little use generally for an electrical paper. If it serve to arouse them to the opportunities in buying, selling or employing American electrical apparatus, our object will have been gained. Foreign customers will find the electrical manufacturer in America open to suggestion and advice from any quarter. We are Americans, it is true, but many of us were Germans, Swedes, Austrians, Italians, Dutchmen, Frenchmen, South Americans and Englishmen first, and we have a tolerably good idea what the countries of the Old and New World want. We are, as a people, abso-

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lutely without ingrained trade prejudices, and the flexibility of the national mind and the readiness to learn will long continue. Sometimes the manufacturer knows best what his customer wants, and as there are probably more electrical goods made in America than in all Europe, it is likely that the best styles and forms have been hammered out here by test and use. Be that as it may, we trust that foreign markets will become better and better acquainted with American electrical goods; and we beg to tender our services freely to all who may wish to make inquiries and get in touch with American electrical manufacturers, engineers, inventors and contractors.

Marie Corelli on Electricity.

THE melodramatic novelist who has depicted the sorrows of Satan, has now been emboldened to discuss the electricity of Christ. It is stated that with the approval of distinguished theosophists, she has advanced a theory which makes Christ the centre and source of "the earth's electric currents." She finds in many of the most remarkable historical events of the Old and New Testaments striking instances of electrical phenomena. She would place in this category the thunder and lightning of Sinai, and the fire in the burning bush which burned but did not consume. All these were electrical manifestations of the all-pervading Spirit. The fire which bore Elijah, the radiance of the Son of Man who walked in the fiery furnace, the Spirit descending in the form of a dove at the Jordan, the light of the transfiguration, the tongues of fire at Pentecost, and the light which dazzled Paul near Damascus, were all electrical theophanies—specializations of that one ever-present fluid which in physics we call electricity, but which in the unseen world of the soul is known as the Divine Spirit. And the office of the Spirit is to reveal Christ; or, in other words, the Spirit is Christ.

We have no wish to enter upon a controversy with the Corelli or be other than devout, but we would like to offer objection to this talk about "fluids." It is also pertinent to point out that the earth's electric current is for aught anybody knows a quite negligible quantity. No one uses it. Such atmospheric effects as the world is familiar with are directly deducible from antecedent causes in the sun's heat, to which also may be traced directly the electricity obtained from the consumption of fuel and from the utilization of falling water. But the "earth's electric currents" are out of practical calculation, except in the way of figuring on the earth's static charge. There is no doubt that electricity will explain many tricks of the prestidigitateur, just as Faraday showed how the spiritualistic phenomena could be obtained materialistically; but no thaumaturgist we know of has ever utilized the "earth's electric currents" for any successful fooling. Daniel Drawbaugh, one of the pseudo inventors of the telephone, got up a clock to run by such current, but we doubt if it is keeping time to-day, or ever ticked truly. Telegraph operators regard earth currents generally as very much of a nuisance—parasitical intruders that disturb smooth working when they happen to break in casually on a well balanced circuit.

We have a lurking suspicion that Marie Corelli hasn't the remotest idea of what electric currents are. Just what electricity is as a natural phenomenon remains a mystery of physics, but some principles and facts are pretty well known, and they hardly justify a sensational novelist in the imposition of ignorant hands on sacred things.

Auto-Mobile,-Truck or-Wain.

A COMPANY which proposes to do most of the heavy trucking in cities by means of compresed air has just made its appearance and announcement. Some of the men associated are already well known in electrical work and in other lines of compressed air enterprises. Their plans as noted elsewhere in this issue are interesting and will, it is to be hoped, enjoy a large measure of success. Believing as we do that electricity is destined to capture a large share of the "horseless vehicle" business, we believe not less in the general availability of other motive powers, and in their desirability or superiority for special lines. Compressed air may well be one of the leaders in certain fields. So may liquid air for that matter. The thing to do is to improve the streets, clear the horses out of the cities, and then have the various automobiles settle the question of permanency and merit by the usual and inevitable process of natural selection.

This compressed air company calls itself "Autotruck," and a wail of complaint has at once gone up from those who have constituted themselves preservers of the purity of our language, failing an Academy. Some one has suggested "Autowain" because it is not such a mouthful of consonants grating against one's teeth. Now, "automobile" is good, but it is nobody's perquisite, and what the new companies and new inventors want is a name that is a trade-mark. We now say "surrey" or "victoria" or "brougham" or "hansom;" and some day with as much instant definiteness we may say "riker" or "hunter" or "condict" or "sperry" or "woods" or "salomorris," depending upon the success and popularity of the type evolved and put on the market. Such words will at once pass into the language, but until that happy time, we must perforce fall back on "automobile," "autotruck" or anything else that happens to please the exploiter. Michael Faraday had a lovely habit, by the way, when making his grand discoveries in electrical science of taking modestly the advice of the famous Whewell on points of new nomenclature, and we would suggest that our electrical wordmakers might well consult Houston in advance before they get into his dictionary. But even Faraday and Whewell picked out words that have not been winners in the race for life. Just why some words survive when others do not, is paralleled in mystery only by the same conditions amongst human beings, but it certainly does not depend upon the mere sweetness of the sounds or the mere technical accuracy of root derivation.

As to the vehicles themselves, no matter how named, it is evident from recent transactions that American makes have a splendid opportunity abroad. The actual terms of the Chicago contract, we are informed, call for 250 carriages a year at an average price of $1,000, for five years. That in itself represents $1,250,000 from foreign trade for one concern—and there are others. All of this goes to confirm our belief that as with street railway motors, our American automobiles are far ahead of any others in the world. Their ability to run on the average miserable paving of our new American cities renders them easy victors on European roads that have been a-making for a thousand years.

Revolution by Telephone.

WHEN one considers how much may be done by a telephone call, it is surprising that resort should be made to less ethereal methods. The trouble is it takes so long to familiarize the public mind with a new utility, and the curious feature is that the outlander and barbarian is often the quickest to "catch on" to the new possibilities. The Sandwich Islands, for example, are far ahead of any other country in their practical appreciation of the telephone, in daily social and business affairs, and now a story comes from Central America which introduces the same appliance as the last refinement in politics. This is to tell how Gutierrez lost the presidency of Salvador. General Tomas Regalado had been placed by President Gutierrez in command of the national military forces, stationed in San Salvador, the capital city of the republic. General Regalado knew that the Salvadorians were intensely hostile to the idea of their country being handed over to the schemes of Zelaya and Bruilla, the Presidents of Nicaragua and Honduras respectively, and he saw his chance to bring about a revolution and make himself Chief Magistrate of his country. Having first come to an understanding with his subordinates, General Regalado from the artillery barracks, on the evening of Nov. 14, "called up" President Gutierrez on the telephone, and boldly said to him: "Ya Ud no es Presidente, todos los cuarteles estan conmigo!" ["You are no longer President! All the battalions are in my favor!"] This was enough for Gutierrez, who with a single "Hello," accented acutely on the first syllable, left the presidential palace instanter, fled to Honduras, and yielded place and preferment to his shrewd but unseen interlocutor.

Why cannot all revolutions be effected this way? The plan is respectfully submitted to the Czar's disarmament conference. The telephone is mightier than the torpedo.

It will be remembered as one of the charming episodes of the invasion of Porto Rico, that in capturing one of the seacoast cities, a young American officer went to the lighthouse of the port and by telephone insisted that the authorities surrender immediately. It was far in excess of gunshot range, we believe, but an amicable arrangement for the hoisting of the Stars and Stripes was soon reached. Now, this was much better than a bombardment, in the ratio of 15 cents for a long distance telephone call to $150,000 or $1,500,000 for shot, shell and general smash.

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Röntgen Rays.[1]

BY PROF. W. C. ROENTGEN.

IF an opaque plate be arranged between the vacuum tube and a platinocyanide-barium screen, even pretty close to it, there is some fluorescence, which is cut off when the air situated laterally is sheltered from the impact of Rontgen rays by a thickness of lead. The effect is not due to the bending of rays; but the air, when struck by the rays, sends out Rontgen rays in all directions; so that if our eyes were sensitive to these rays, a vacuum tube would appear like a lamp in a room filled with tobacco smoke, and possibly the light from the tube and that from the air would have different colors, though there are at present no means of testing this question (whether the air acts by simple diffused reflection or as a quasi-fluorescent substance), for the rays from the air are also photographically active.

For comparative measurements the author uses a simple vertical plate of lead along the mid-line of a table; the fluorescent screen is placed at right angles to this, so that half the screen looks toward the left and half toward the right side of the partition. The two tubes to be compared are placed one on each side of this partition, and each then affects only one-half of the screen. In using this it is found that the tubes are very inconstant; they are sensitive to irregularities in the make and break (worse with Foucault's than with Deprez's contact breaker); and when the outbursts of Rontgen radiation follow one another so rapidly that the eye cannot detect any want of continuity in the phosphorescence on the screen, the brightness of the screen depends on the intensity of the radiation from the platinum plate of the discharge tube, on the kind of rays reaching the screen, on the distance between the screen and the tube, on the absorption undergone by the rays before reaching the screen, on the number of discharges per second, on the phosphorescent afterglow of the screen, and on the radiation to the screen from surrounding objects. From a flat plate the radiation is equal in all directions up to about 80 degrees from the normal, and the difference is only well marked at between 89 degrees and 90 degrees. The mode of experiment consisted in flexible photographic films bent to a half circle half surrounding the source; there is no ascertainable difference between the radiations at different angles; the photographic effect increases, except in extreme cases, with the angle between the source of rays and the photographic plate. There is an analogous case of equality in all directions in optical fluorescence. Drop fluorescein into water in a square tank illuminated by white or violet light, and the walls of the columns of the fluorescein solution appear the brightest, i. e., where the angle of emanation of the phosphorescence light is the greatest. Stokes has explained this through the fluorescence light being much less absorbed by the fluorescein solution than the exciting rays are. So here, the exciting cathode rays are much more absorbed by platinum than the induced Rontgen rays.

The sharpest shadows are obtained by tilting the platinum away from parallelism with the photographic plate through not more than 80 degrees; and the impression is then the most intense. In the absence of disturbing effect from the air, and on condition that the radiations remain of the same kind, the brightness of a fluorescent screen varies inversely as the square of its distance from the source.

Splitting a solid into layers makes no difference in its transparency; nor does putting it nearer to or farther from the screen. Rays which have traversed one thickness traverse another more readily (in proportion); so that the specific permeability (fraction of radiation let through a layer of unit thickness) is greater the thicker the object. When two plates of different substances are equally permeable, this equality disappears if the plates are equally thickened or thinned; with plates of Pt 0.0026 mm. and of Al 0.0299 mm. thick, one Pt = six Al; but two Pt = sixteen Al. Other similar numbers are given for other tubes. The relations between the equivalent thicknesses of two substances vary with the thickness and the nature of the material (e. g., the walls of the vacuum tube) traversed by the rays before reaching the screen. The author uses a platinum foil, 0.0026 mm. thick, with fifteen holes in it, closed respectively by single, double, . . . fifteen fold thicknesses of aluminum, each of 0.0299 mm. thickness. When this is interposed, a glance shows which thickness of aluminum is equal to 0.0026 mm. of platinum.

The corresponding number of aluminum thicknesses is called the "window number," the apparatus being called a "platinum window." Example: With direct radiations the window number was 5; on interposing 2 mm. soda glass, the window number became 10; the rays filtered through the glass found it relatively easier than before to traverse the aluminum. Rays sent through this platinum window and then through a dozen photographic films indicated the window number 10 for the first film and 13 for the last.

Conversely, one and the same substance is differently permeable to rays from different tubes; lowest vacua, least potential of discharge, "softest" tubes, least power of penetration; highest vacua, highest potential of discharge; "hardest" tubes, greatest power of penetration. With the former, window number say 2; with the latter may be beyond 15. With the former, simple shadows of the hand; with intermediate exhaustions good bone shadows; with the last, bones also permeable. With one and the same tube the quality and penetrating power of the rays depend upon the action of the contact breaker (which fluctuates), the length of spark gap paralled to the tube in the secondary circuit, the introduction of a Tesla transformer, the amount of vacuum, and other uninvestigated changes within the tube itself. Putting a tube on the pump at the lowest sufficient vacuum, with small spark gap parallel to the tube, the tube is very "soft," the rays absorbable, and the window number small. Putting in a Tesla transformer, or a spark gap in series, the tube is "hardened." With a Tesla transformer in circuit, with narrow tube and wire electrodes, the rays are given off in air at 3.1 mm. Hg., and at still lower vacua in hydrogen.

The highest vacuum under which the rays can be given off is beyond 0.0002 mm. Hg. As the vacuum is increased, the spark gap must be at the same time lengthened; and when the tube is so "hard" that the spark gap has to be more than 20 cm. long, the rays will go through 4 cm. of iron. The tube will also become harder through its own continued action; so "hard" that a shadow photograph of a gunlock at 15 cm. distance can be taken in 12 minutes—a relatively long exposure, because the rays go through the photographic film instead of affecting it. This hardening is due to self exhaustion, and to some change in the electrodes themselves.

A tube, if too hard, can be softened by letting in air, by warming it, by reversing the discharges, or by driving very powerful discharges through it. In the last case, the necessary potential of discharge becomes high, but the rays are very absorbable and the window numbers low. It appears that the kind of rays emitted depends on the mode of discharge, however this may be attained. The same mode of discharge would give the same Rontgen rays, even at relatively high pressure. The quality of the rays is not affected by the strength of the primary current, assuming that the contact breaker acts equally at all current strengths; but their intensity is affected. Therefore, (1) the radiations from a tube are mixed, and differ in absorbability and intensity; (2) the composition of the mixture depends on the mode of discharge; (3) different rays are absorbed by different substances; (4) cathode rays resemble Rontgen rays in many respects, and the two discrepancies (a) difference of absorbability, and (b) the permeability to the two kinds of rays according to the density of the substance not following the same law, may be found bridged over by further researches leading to the discovery of rays of intermediate condition, say the Rontgen rays in ultra soft tubes and extremely thin windows, or the cathode rays in ultra-hard tubes.

Photographic results follow the fluorescent screen pretty closely, particularly with soft tubes; but with hard tubes the window number seemed a little lower than with the screen. When a hard and a soft tube bring the two halves of the fluorescent screen to the same brightness, a photographic plate put in place of the screen is less affected by the rays from the hard tube; in the latter the rays go through the film, and will go through 96 films and impress the last one while the first is scarcely over-exposed. For this special reason, hard tubes require longer exposures; very soft tubes need longer exposures on account of their feebler intensity.

In a tube in action, Rontgen rays come not only from a minute area on the anticathode, but, more feebly, from the whole

[1] From the German.

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plate and a part of the walls of the tube. Cathode rays go in all directions from the cathode, but only feebly except along the axis. When the tube is hard and the platinum anticathode very thin, Rontgen rays start in considerable quantity from the back of the latter; and in very hard tubes the point which most emits Rontgen rays can be shifted away from the anticathode by a magnet.

Continued experiments show no difference in the permeability of any crystal according to the direction of the axis. It is the case that the eye can sometimes perceive the presence of Rontgen rays; this is due to the setting up of fluorescence in the retina; and with hard tubes, looked at through a narrow slit in a lead sheet, it is not difficult, by moving the slit, to get changing luminous figures. Nothing which may really be referred to diffraction has been discovered, though repeatedly sought for; apparent instances have all been found to be otherwise explicable.

MISCELLANEOUS

Electrical and Business Outlook in Cuba.

BY ALFRED J. THOMPSON, San Ignacio, Havana.

THE "keynote" to future commercial intercourse between the United States and Cuba depends for its harmony on how it is struck. If the United States maintains its present attitude it will be a minor chord, but if it will bear in mind the fact that over 300 years of dealings with Europe has given Cuba great confidence in her people and her products, then it will realize that in order for the United States to sell in Cuba it must give more attention to the "terms" of her offers than to the "prices."

In the future it will not be difficult for the North Americans to meet the Europeans in this island and even to worst them in great part, if we consider the colossal American wealth (important factor in labor and commercial relations), and the prestige and renown lately acquired. But for the present, the Americans will not be able to destroy the existing commercial conditions because these conditions and customs do not conform with the present general character of business here, but it is a fact that so soon as politics will allow, and Cuban cash is more plentiful, Americans will "close the ports" to foreigners who compete or may be in a position to do so against them, provided their "terms" are modified.

Cuba wants to deal with the United Stataes, and it cannot be denied that the United States wants to deal with Cuba, as such desires are demonstrated by the thousands of circulars and letters arriving from the United States containing offers to this mercantile community, together with catalogues of manufacturers, all showing the great desire of Americans to mingle with Cubans and find a field of commercial operations.

As an example of American prohibitive methods, let us take these catalogues and, after writing, requesting the prices, discounts and best terms, we are brought face to face with export America's greatest mistake, for 99 per cent. of her quotations will read as follows: Price, so much per cent. discount, F. O. B. New York or shipping port; terms "cash" against bill of lading (arranged of course through some banking representative).

Now, compare this "cash down" policy with the liberal time terms offered by the English and German markets, sometimes extending as long as five years on large amounts to men with good credit. Then the American producers will see how difficult it will be to displace European products sold under such convenient terms.

During the early nineties, the years of my first experience in Cuba, Americans could and did sell over Europe simply because the disastrous war had not then robbed the Cuban of his ready cash, which of course permitted him to buy in the cheapest market. And when those financial conditions of the islands are restored, America's cheaper and perhaps better productions will close out the European goods, but not before.

If America had made the study of the present conditions and requirements of the island, as England has, she would perhaps bend a little from her stiff C. O. D. policy, which, if maintained, will surely prove disastrous to an immediate Cuban trade.

What I have said refers to trade in general and the machinery line in particular. Take my own electrical and machinery line for instance. I find a large sugar planter, whose cane and engine house has been almost ruined by the insurgents' fire, and all his ready cash given to his fifteen or twenty-five farmers that they may plant new cane, upon which his immense mill depends for supply. His crude gas—or miserable "horse oil" lamps have also been stolen or destroyed. However, I convince him of the economy of the electric light, and he decides to think it over, and to an old hand at the business shows every indication of being a "probable buyer" until the "terms of payment" are stated. This knocks the whole idea on the head, and he tells me it is impossible to meet these terms, with all the emphasis on the words such as they alone can lay.

But by this time he is appreciating what a big improvement the electric light would be and has also learned just what he needs, so he communicates with some English house on the matter, stating what he can do in the way of payment, of course referring to A1 men as guarantors that the conditions of the contract shall be maintained, and the deal is closed. The "wise guy" of an Englishman can see that such terms are equivalent to cash, in fact better, as I have known many instances where 10 per cent. has been added to the price, in consideration of the credit terms of the contract.

The people want electric light and power, and I find myself very busy, but I plainly see that the machine will first be sold whose producers can first appreciate the fact that the Cuban must grow his cane, grind it and sell his sugar before he can realize the cash on his crop with which to pay for the machinery which did the work.

These conditions will not always exist, for surely the agriculturists are waking up to renewed activity in farm labor, and this is to be the island's redeemer, since along that line lies Cuba's main source of wealth. The following extract from the "Commercial Adviser" of Havana, a Spanish publication, gives their idea of the situation in a few remarkably pithy words. It says: "The commerce of Cuba does not need a greater stimulant than its own interest, in the imperatively incessant work for the development of the country. But, following a war into which we were drawn by inexcusable greed, and out of which we came forth defeated without fighting, it is not illogical that we should feel somewhat sad and unnerved. Against this state of things, however, commerce should struggle for existence with prudence and tact, considering that there is no remedy for the late happenings, and that the principal cause of our misfortune is not Yankee greed, but the negligence of our own government, because every people and every individual has the right to seek aggrandizement, while the apathy, negligence and inaptitude of our own men in power has been unpardonable. We should therefore work within the new order of things created, accepting and seeking the American products that are to supply the future market, and, to a great extent, replace the Spanish."

Perhaps a few words applying directly to the electrical line might be more interesting to your readers than generalizing on the situation, and on this particular subject I addressed myself to the guests assembled at the first American banquet ever held in Havana. It was on Thanksgiving Day last. There is not, I remarked, a wider or better opportunity for the application of electrical power than in connection with the sugar plantations of the island, which number about 313; here we have unlimited steam supply, so that the electrical contractor is not handicapped by any boiler considerations. Arc lighting is the better form of illuminating, and in a little time also we will see steam yard locomotives replaced by the electric haulers, principally for economic reasons, as the steam machines must burn coal, which, in many cases, costs $12 a ton, and in 1893 I knew of a case where several tons of coal were delivered near the centre part of the island at $16 a ton. The economy of electric traction in these cases can be seen by a blind man, as the power generators would be located inside the engine house, where steam is plentiful and cheap, because the cost of the fuel is almost negligible here, the boilers all being fitted with special burners for burning the green "bagaso" (or sugar cane "trash") after having passed through the crushing rollers and the juice extracted.

Another large field for the application of motors lies in their geared connection to pumps, etc. The most up-to-date plantation in this island is about 100 years behind the time, and very little if any duplicated machinery exists, consequently it frequently happens that a pump will become disabled, necessitating the stopping of the grinding machines and often causing the entire system to be "shut down," sometimes for a whole day, and

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there are many plantations large enough for this delay to mean a loss of $1,000 a day.

With a couple of such motors in hand ready for immediate connection to pumps, cane conductors, centrifugals and other more or less light machinery, the frequent and expensive delays could be easily avoided, and for a very small investment.

The Crocker-Wheeler Electric Company, which I represent here in generators and motors, have done a great deal of this special work, so that for some months past I have been "on the spot" with cuts, photos, etc., of such machines actually in operation.

Another subject (since the insurgent war more seriously considered than ever) is the one of fire alarm and protection, and where this system can be installed with the electric light wires for moderate cost, I foresee a large demand.

The question of electric traction is a tremendous one, and one with wide possibilities, on account of the scarcity of steam railroads, though the excessive rains from June to September (such as New Yorkers cannot imagine) will prevent the successful operation of the underground trolley system. However, many American cities have demonstrated that even the overhead trolley can show a neat little dividend. So even an investor in Cuba may not be disappointed.

The telephone has perhaps the widest range—the present systems are in a terrible state of "dry rot"—with speaking distances very limited, and I shall hail with joy the day when we can interview Cienfuegos and Santiago without spending a day and a night in a "snail's gait" coasting boat, and at a considerably smaller cost.

The business conditions are very suitable to successful telephonic operation, though the present extremely favorable intercity opportunities will be somewhat reduced by the advancement of traveling accommodations such as electric traction will supply.

I find my time stealing along, with plenty yet to do, so will invite any of your readers to write me for further details of electric probabilities in Cuba, or who should need any information such as seven years' electrical work on the island might have fitted me to supply.

Export and Import Trade of the United States.

THE exports from the United States in the calendar year 1898 will exceed those of any earlier year. Only twice in our history have the exports in a calendar year passed the billion-dollar line; in 1898 they will be a billion and a quarter. During the eleven months of 1898, ending with November, they are greater than in any full calendar year preceding, the total for the eleven months being $1,117,681,199, and it is apparent that the December statement will bring the grand total for the year above one billion two hundred and fifty million dollars. The November, 1898, exports were $129,783,512, and as those of December are almost invariably larger than those of November, it seems not unreasonable to believe that they will be sufficient to bring the grand total for the year past the billion and a quarter mne. Certainly the record for the year will by far surpass that of any preceding calendar year. The figures of the Treasury Bureau of Statistics show that the November exports are not only the largest in November, but the largest in any month in the history of our commerce; while, as already indicated, those of the eleven months ending with November are larger than those of any full calendar year prior to 1898. Of breadstuffs, the exports for the eleven months ending with November, 1898, are the largest in our history, being $277,135,341, against $223,211,617 in the great exporting year of 1892; provisions are for the eleven months $148,417,850, against $125,297,007 in the eleven months of 1892. Cotton for the eleven months amounts to $192,323,391, a figure slightly below that of 1896, though the total number of pounds exported by far exceeds that of the corresponding months in any preceding year, being for the eleven months 3,436,032,504, or, measured in bales, 6,722,283, a larger total in bales or pounds than that of any full calendar year preceding.

The import record of the year 1898 will be as remarkable as that relating to its exports, but for opposite reasons, the total imports for the year being less than those of any calendar year since 1885. For the month of November they were but $52,109,560, which was slightly less than those of November, 1897, and less with three exceptions than those of any November since 1885. For the eleven months ending with November they were but $579,844,153, while those of the corresponding months of 1897 were $691,089,266, and those of the eleven months of 1896, $622,598,896. It is thus apparent that the imports for the full calendar year 1898, will not exceed $640,000,000, a sum less than that of any calendar year since 1885, and fully a hundred million less than that of the calendar year 1897. With the largest exports our history, and the smallest imports in many years, the year 1898 will naturally show the largest balance of trade in our favor ever presented in any calendar year. The figures for the eleven months show an excess of exports over imports amounting to $537,837,046, and it is quite apparent that the December figures will bring the total excess of exports for the calendar year above the six hundred million dollar line.

With the largest exports of merchandise in our history and smallest imports in many years comes the largest importation of gold in any calendar year. The gold imports for the eleven months ending with November, are, in round terms, $150,000,000, the accurate figures being $149,396,370, while no full calendar year save 1896, ever reached the hundred million dollar line, and in that year the total for the twelve months was but $164,731,259. The effect of this large importation of gold in conjunction with the increased production from our own mines, is plainly visible in the increased circulation of that metal.

Exports of Electrical Material from New York.

The following exports of electrical material are from the port of New York for the week ending Dec. 31, 1898: British East Indies—9 cases electrical material, $2.10. Berlin—2 cases electrical machinery, $200. Brazil—33 cases electrical material, $1,748. British Australia—44 cases electrical machinery, $3,700. Bremen—1 case electrical machinery, $315. British Guiana—8 packages electrical material, $83. British Possessions in Africa—1 case electrical material, $60. British West Indies—21 packages electrical material, $663. Central America—189 packages electrical material, $4,838. Cuba—35 cases electrical material, $2,441. Ecuador—45 packages electrical material, $952. French West Indies—1 package electrical material, $18. Genoa—1 case electrical material, $130; 2 cases electrical material, $33. Hamburg—22 cases electrical material, $1,183; 1,224 gallons varnish, $3,100; 99 cases electrical material, $17,176. Hayti—5 packages electrical material, $187. Havre—5 packages electrical vehicles, $1,675. Liverpool—57 packages electrical material, $2,063. London—1 case electrical instruments, $550; 116 cases electrical machinery, $3,800, 16 cases electrical material, $612. Manchester—1 case electrical machinery, $300. Marseilles—2 cases electrical material, $100. Milan—1 case electrical material, $20. Peru—18 packages electrical material, $341. Santo Domingo—4 packages electrical material, $45. Siam—11 packages electrical material, $574. Venezuela—278 packages electrical machinery, $698.

To Thaw Out the Klondike Electrically.

The Graburn and Blaney Canadian patent of the Graburn electrical thawing process has been sold by the inventor, Mr. Nelson Graburn, of Montreal, to the Electrical Thawing Syndicate (Limited), London, Eng., for £7,000 and one-quarter interest in the company. The patent is intended to be used in countries like the Klondike, where mining operations are carried on during a large portion of the year under considerable difficulties, owing to the ground being frozen hard to a considerable depth. It provides for specially constructed dynamos and electrodes, the latter being placed against the walls of the shaft, with a space of from five to six feet of ground intervening; so that when the current is turned on, it has to cross the face of this space to complete the circuit and the ground contained therein, forming a resistance to the motion of the electricity, heat is generated and the ground thawed.

By the bonfire system of thawing in a temperature of zero or lower, it is stated that upwards of 85 per cent. of the heat generated is lost in the atmosphere, whilst heat generated by the above electrical process can be absolutely controlled and applied in such a manner as to utilize its full force and effect. It is also claimed that by the electrical system, it is possible to thaw out one foot of frozen earth per hour, as against one foot in twenty-four hours by the bonfire system.

Several electrical experts who have examined into the system, including Mr. H. F. Parshall, consulting engineer of the British Thomson-Houston Company, etc., are said to be satisfied as to its practicability and efficiency, as correspondence in the possession of Mr. Graburn shows.

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MUNICIPAL AFFAIRS

The Municipal Lighting Plant at Crawfordsville, Ind.

By WESLEY SEARS, Alderman, Jackson, Mich.

SUPERINTENDENT ABRAHAMS, of Crawfordsville, Ind., whose communication appears on pages 618 and 619 of "The Electrical Engineer," of Dec. 22, 1898, raises a quasi question as to the correctness of a quotation appearing in an editorial in your issue of Nov. 17, '98. The quotation in question first appeared in my article on "Municipal Electric Light Statistics," which was published in the October issue of "City Government," pages 145 to 149, and exactly stated is as follows:

"We do own our light; but if we did not, we would not, for in my opinion it will bankrupt any city."

Let it be understood once and for all that all the quotations in my article are taken verbatim from correspondence received from the officials of the cities whose reports appear therein, and the quotation from my Crawfordsville correspondent is not an exception to the rule.

If necessary to prove my veracity in the matter, I will give the name of my correspondent and will submit for inspection the original statement.

Permit a few words relative to the statement of your Crawfordsville critic as to the cost of arc lights in that city. He says: "Our city comprises four square miles, and is lighted, equally all over, by 145 arc lights of 2,000 candle power each. These lights cost the city $47 each per year. Now, then, this cost includes 4 per cent. for depreciation and interest on the investment."

No objection can be made to what Mr. Abrahams says, except in the matter of interest and depreciation; but I must criticise him in that he does not say enough; and it was for this very reason that I severely criticised "Information Bulletin No. 1. Subject; Electric Lighting" issued last February, by the "League of American Municipalities"—it did not tell enough.

The statement of Mr. Abrahams does not say whether lights in that city burn 2,000 or 4,000 hours yearly.

It does not state whether fuel (coal) costs 75c. or $2 per ton or whether, possibly, they use natural gas at a merely nominal rate. It does not give the total cost of plant to date nor the yearly cost for maintenance and operation. It does not say whether the $47 cost per year includes items of insurance and taxes. It does make a ridiculously small allowance for depreciation and interest (4 per cent.) In my statistics I allowed 9 per cent. (4 per cent. for interest and 5 per cent. for depreciation) and have been criticised for making the depreciation item so low.

When Crawfordsville puts its "plant in such condition that it will not only furnish the street lighting free of expense to the city, but will net us a tidy sum of money each month as a clear cash profit," as your Mr. Abrahams says, Jackson wants to know all about it. We are looking for just such a "snap." The best we can do just at present is to buy our lights—2,000 candle power—at 1 78-100 c. per lamp per hour. Our contract calls for 238—2,000 candle power lights, burning at least 3,800 hours yearly for $16,100 per year, with rebate for "outages."

Give us facts, less talk and theory, and more light for less money.

Municipal Ownership in Chicago.

The law provides that if a place is vacant and a man is wanted to fill it, the commission shall certify the name of the person standing at the head of the list of those who have passed an examination for that place. If there have been no examinations, then a sixty-day man can be appointed. It has been discovered that all that is necessary to find constant employment for sixty-day partisan bummers is to change the name of the kind of positions to be given them.

Thus some men were appointed "ward superintendents" before the commission had any eligible list for such positions. When such a list had been made up, and the men on it should have been appointed, a requisition was made, not for "ward superintendents," but "street foremen"—to perform the same duties. But as there was no eligible list of "street foremen" the old "ward superintendents," most of them worthless party hacks, were appointed "street foremen" for sixty days. The water office wanted some men to distribute bills. There are an abundance of "messengers" on the eligible list, but the requisition made was not for "messengers," but "bill distributors." Nobody had passed an examination for that. Therefore sixty-day men were appointed. This trick of changing names can be kept up ad infinitum. It appears also that the examinations have been rigged up in such a way as to put the sixty-day political appointee at the head of the list unless he is so hopelessly ignorant that he does not dare to stand even a friendly examination. The examinations have ceased to be competitive. The man who has no political backing has no chance whatever to get a place, no matter how excellent may be his qualifications.—Chicago Tribune.

TELEPHONY AND TELEGRAPHY

Some of the Latest Practice in "Independent" Telephony, at Battle Creek, Mich.

PROBABLY no line of manufacture has had greater changes or made more rapid progress than is seen in the equipment and systems of independent telephone companies during the past five years, from the magneto telephone for private line use to the present type of battery telephone system with all the modern conveniences. The telephone plant, for example, recently installed by the Calhoun County Telephone Company of Battle Creek, Michigan, shows one of the latest, most convenient and economical systems in the independent field, and is worthy of special note. The system, when completed, will comprise the exchanges at Battle Creek, Albion, Marshall, Bedford, and a network of toll lines throughout the county, connecting all the small towns and many of the representative farmers.

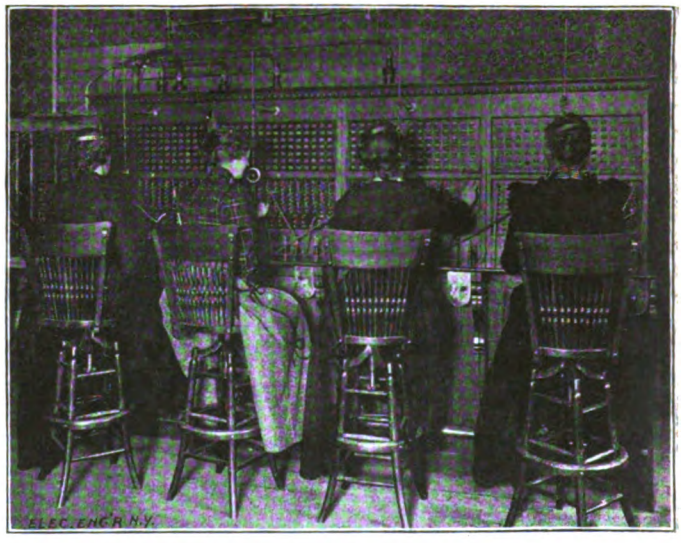

FIG. 1.—BATTLE CREEK, MICH., TELEPHONE EXCHANGE.

It has connection with more than 300 towns and cities in the State, enabling any subscriber in the entire plant to communicate with any of these stations, extending from Michigan City, South Haven, St. Joseph and Benton Harbor on the West, to Detroit on the East, and from South Bend, Indiana, on the South, to Cadillac, Michigan, on the North.

The exchange at Battle Creek—the centre of the county system—was the first to be installed. Through the eagerness of the subscribers, the exchange was opened for operation about three months ago, when the first twenty-five instruments had been connected. The company now has 500 subscribers. In the outlying districts some are being temporarily connected on

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party lines. The equipment used throughout the entire plant was manufactured by the Stromberg-Carlson Telephone Manufacturing Company. Fig. 1 shows the exchange switchboard. The board is made up in sections of 100 lines each, and has

FIG. 2.—MANAGER'S OFFICE.

trunking capacity for a 1,000-subscriber exchange. Additional sections may be added as required without altering the original equipment.

The trunking jacks are placed immediately underneath the subscribers' jacks. The board is well protected from lightning and other heavy electrical currents by S. C. fuse and carbon lightning arresters. Fig. 2 shows the manager's office, with several portable desk instruments, the State line testing board, wall style, and the toll line switchboard.

The toll board is fitted with ten toll line equipments and has three trunking jacks to each section of the exchange board. It is also furnished with monitor spring jacks, enabling the State line operator to talk direct with any operator on the exchange board or to listen in on the operator's circuit without ringing.

The testing board is for testing the long distance service through State trunk lines. Each line equipment in this board consists of a high-wound ringer and bells, and three specially designed spring jacks. One jack is for making connection between the through trunk line and the local toll line switchboard. At the other two jacks, either wire of the line can be connected to the ground or the lines opened or short-circuited. This enables an operator to test the line either way for any trouble on the lines, or to learn readily if the trouble is in the office instrument.

Fig. 3 shows the main talking and ringing energy plant,

FIG. 3.—MAIN TALKING AND RINGING BATTERY PLANT.

The power generator shown furnishes the current to all the subscribers for ringing the central office. It is run by an electric motor. The battery plant shown supplies the entire talking current for the 500 subscribers' instruments, as well as the operators' telephones. It consists of two batteries, each of fifteen storage cells, charged from a power plant. One set is being charged while the other is in use. By means of the switch at the side of the battery shelves, either set is thrown into operation, and at the same time the other set is thrown upon the charging circuit. A second switch is used for throwing off the charging circuit entirely. Either one of these sets can also be used for a subscribers' ringing-in battery.

The plant is also provided with an emergency equipment of twenty cells of Gordon battery. This emergency battery can be used for furnishing power for subscribers ringing central in case of accident on the power generator, or for talking current, should the storage batteries at any time fail. It will readily be seen that ample provision is made for almost any emergency.

Fig. 4 shows a police box equipped with an S. C. double pole receiver and long distance transmitter. These transmitters and receivers are especially adapted for such purposes and can be used with any make of police system. The receiver has all parts firmly clamped in the brass adjustable head, which is securely locked when in proper adjustment, making it practically impossible to get out of adjustment or be affected by the greatest variation of temperature. The cord running directly into the

FIG. 4.—POLICE BOX.

shell, leaves no binding posts to break and cords to become loose and disconnected.

The transmitter, being sealed, and the heavy metal diaphragms protected with an auxiliary diaphragm or weatherproof material, cannot get out of order from dampness, to which instruments in these places are subjected. The telephones in this system are supplied with battery from the central at police headquarters, thus leaving no batteries to deteriorate, freeze, or otherwise become out of order at the various stations. The police telephone system can be connected at police headquarters with the public exchange, which enables a patrolman to call up any subscriber from any one of the patrol boxes. This feature is sometimes very desirable late at night, when public telephone stations are closed.

There are also a number of private plants, both inter-communicating and central station systems, connected with the exchange. It can be readily seen that with outside construction put up in a substantial manner and with the exchange equipped with a system of this type, it can cost but very little for maintenance and require practically no attention outside of the central office, being certainly a great step in advance of the regular individual generator call and local battery systems. It is understood that the manufacturers of the system will put on the market in the very near future, a multiple switchboard for use in connection with their "central energy" system, adapted for use in any sized exchange.

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Independent Telephony in Illinois and Indiana.

S. P. Sheerin, one of the chief promoters of the New Telephone Company, who has been in attendance at the meeting of the independent telephone exchanges of Eastern Illinois and Western Indiana, at Paris, Ill., returned to the city, last night, says the Indianapolis "Journal" of Dec. 22. With Mr. Sheerin were A. F. Ramsey and George W. Beers, representing the associated independent telephone lines of Indiana. The object of the Indiana men at the meeting was to secure an agreement by which toll business would be interchanged between the Illinois and Indiana independent lines.

The Illinois lines represented at the meeting controlled 10,000 telephones and about 2,000 miles of toll lines. During the meeting representatives of the Ceneral Union and Bell Telephone Companies, it is alleged, made overtures similar to those rejected by the Indiana independent companies at Lafayette last Saturday. None of the propositions were received with favor and, after short speeches against making any arrangement with the old companies, were rejected. The following exchanges were represented at the meeting: Oakland, Kansas, Mattoon, Sullivan and Cole County, Hume, Sidel, Clinton and Danville, Ill.; Chrisman and Dana, Ind.; Ridge Farms, Paxton, Watseka, Hoopeston, Paris and Charleston, Ill., and the Citizens' of Terre Haute.

A special dispatch from Paris, Ill., of Dec. 21, says: Twenty-five representatives of independent telephone exchanges in Illinois and Indiana held a meeting here to-day at the instance of the Bell Telephone Company, to discuss a proposition looking to the interchangeable use of its lines with those of the independent companies. The meeting was called to order by Dr. I. A. Lumpkin, of Mattoon, president of the association, and the question of any prospective amalgamation with the Central Telephone Company was discussed with considerable warmth. Finally, to test the sentiment of the meeting, a resolution was introduced by Ramsey, of Crawfordsville, rejecting in the most positive terms the overtures of the Bell Company, and declaring that neither now nor at any future time would any proposition for the interchangeable use of lines be considered. The representatives comprising this association have over ten thousand telephones in operation.

A special dispatch from Lafayette, Ind., of Dec. 17 says: The most important telephone meeting ever held in the State was held at the Lahr House here to-day. The Bell Company has been for some time endeavoring to get control of the Western Indiana Telephone Company and the Jasper County Telephone Company, two organizations controlling a large number of exchanges and many miles of toll lines.

The meeting to-day was for the purpose of considering and disposing of the Bell proposition, which was unanimously declined, and a twenty-five-year contract was entered into with the Lafayette Independent Telephone Company and the New Long Distance Telephone Company, of Indianapolis. The following towns and cities were represented: Rennselear, Goodland, Fowler, Earl Park, Monticello, Wolcott, Brook, Morocco, Pine Village, Boswell, Ambia, Oxford, Kentlands, Remington, Reynolds, Idaville, Burnettsville, Monon, Chalmers, Brookston, Otterbein, Attica, Williamsport, Covington, Watseka, Ill. The New Long Distance Telephone Company was represented by S. P. Sheerin, A. F. Ramsey, H. B. Gates and George W. Beers.

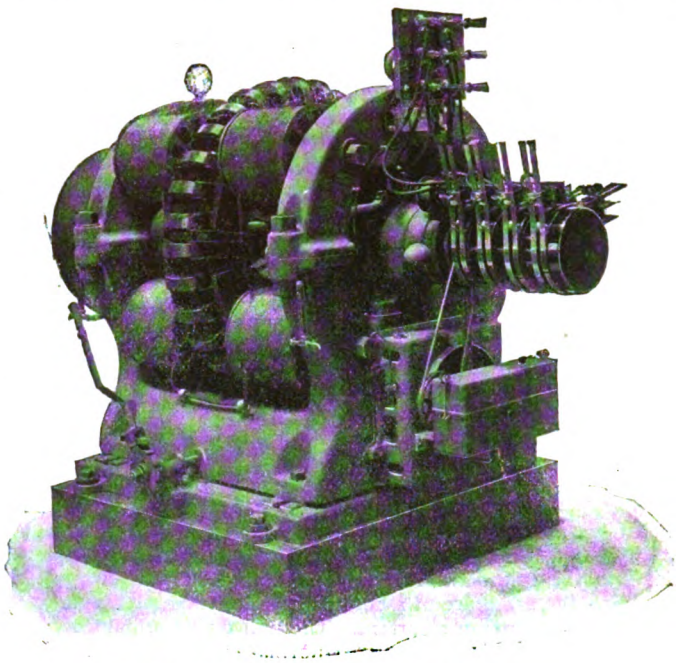
Combining Opposition Telephone Companies.

A special dispatch from Boston, of Dec. 29, says: It is learned that prominent Boston interests are engaged in forming a combination of all the telephone companies throughout the United States which are opposed to the Bell Telephone Company. Already a majority of such telephone companies have signified their intention to sell out to the new company. The People's Telephone Company, of New York, of which Mr. Darwin R. James is president, has been approached by the promoters of the new concern, but has not yet decided to come in. The feeling here is that the new combination will be conducted in harmony with the Bell Telephone Company, and will practically do away with all competition in the telephone business, just as has been the result of the formation of the Federal Steel Company, working in harmony with the Carnegie Works, and in various other large industries, notably that of the distillers.

NEWS & NOTES

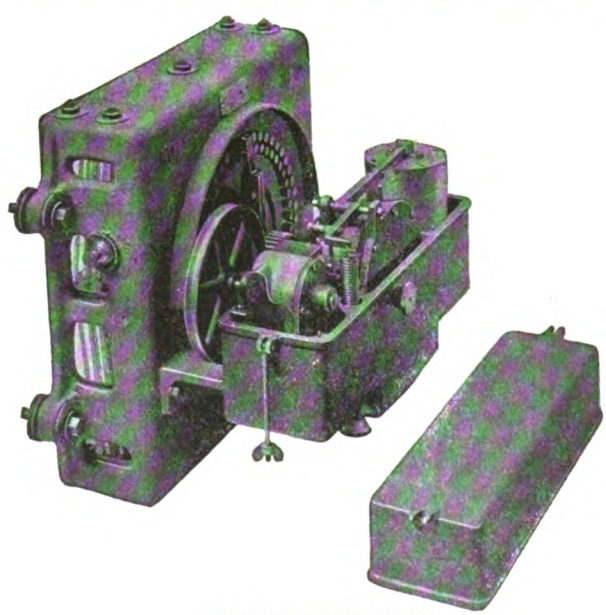
G. E. Form 2 Brush Arc Regulator.

AS the series arc lighting generator has been gradually increased in size the adoption of improved methods of regulation has become more imperative. The nerve centre of a



BRUSH MULTIPOLAR ARC GENERATOR.

series arc system being the regulator, however nearly perfect the other apparatus may be, satisfactory lighting cannot be obtained unless the regulator itself performs its full duty. The General Electric Company has, therefore, developed for four pole Brush arc generators, the Form 2 regulator, the design



FORM 2 REGULATOR.

of which is the outcome of careful study and investigation, as well as the examination of data obtained from the operation of Brush arc regulators throughout the country.

The Form 2 regulator is simple both in construction and operation. Its mechanism is contained in a rectangular case placed

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on the machine directly beneath the commutator. A separate wall controller is not required; hence no additional leads need be run from the generator. In maintaining constant current the regulator performs two simultaneous operations, viz., it sweeps a set of rheostat contacts, varying the resistance of the field shunt and rocks the brushes back or forth to keep the spark length at a minimum.

The mechanism consists of a rotary oil pump, driven by a

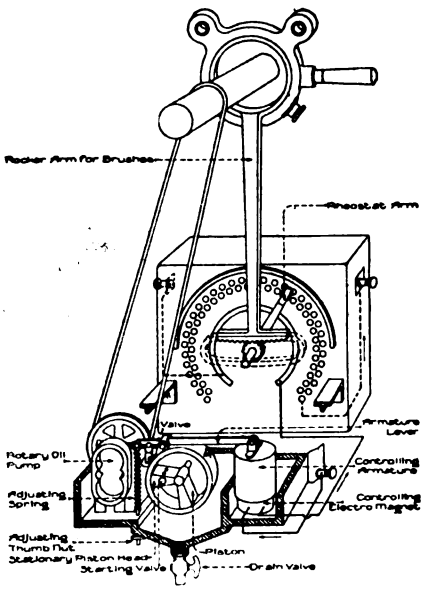
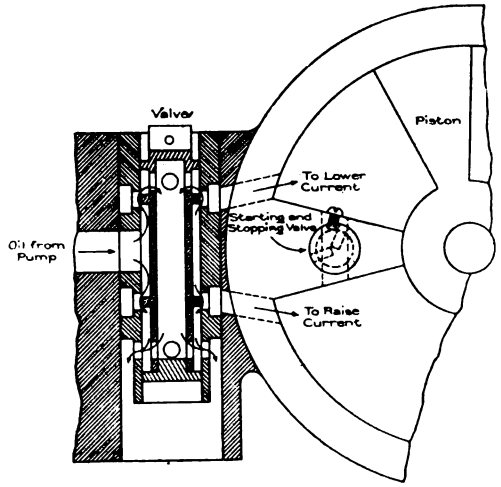


DIAGRAM OF PARTS OF FORM 2 REGULATOR.

belt from the armature shaft, a rotary piston in a short cylinder with ports, and a balanced valve, which regulates the flow of oil into the cylinder. The valve is operated by a lever which supports the armature of a controlling electromagnet, energized by the main generator current. The pull on its armature varies therefore, with this current. At normal current the valve is in its middle position and the oil may flow through the overlapping ports and back into the case without moving the piston. Should the current rise above normal, the controlling armature is drawn down raising the valve and diverting the oil through the upper ports into the piston, at the same time allowing it to run out from the piston case through the lower ports as the piston rotates in a clockwise direction. As the piston is mounted on a shaft, moving the rheostat arm and the brush holder rocker arm, its movement immediately corrects the rise in cur-



SECTIONAL VIEW OF VALVE IN MIDDLE POSITION.

rent. When the current returns to normal the controlling magnet releases, and the valve lowers and prevents further flow of oil against the piston, which remains stationary until the valve is again moved to compensate for any change in the current. Should the current fall below normal, this operation is reversed.

The high efficiency of this regulator is due to the fact that it does not "hunt," i. e., constantly attempt to change the current. When the current is subject to a sudden and large variation, the controlling magnet is affected in the same proportion; hence the ports are opened wide and the full pressure of the oil is brought to bear on the proper side of the piston. As the current approaches normal the controlling magnet weakens and the valve is gradually moved towards its middle position, which it reaches just as the current returns to normal.

It is evident that the piston and, therefore, the rheostat arm and the brushes will move more rapidly when the ports are wide open than when they are nearly closed. The means for correcting variations of current are thus most effective when most needed. The actual time required to bring the current back to normal from a dead short circuit is from 3½ to 4 seconds. The use of rapidly moving reciprocating parts has been avoided, and when properly adjusted, the regulator operates without oscillating action.

At one end of the armature lever is an adjusting spring, the tension of which is regulated by a hard rubber knob outside of the box. With this spring the armature may be adjusted for a predetermined current and this is the only adjustment necessary.. As the spring is not in circuit and is not subject to temperature changes, the adjustment is not likely to change. The adjusting knob may be handled without danger when the machine is in operation. The stops for the controlling lever may be so arranged that the regulator will operate more quickly in one direction than in the other, while a device is provided which allows the regulator to be thrown entirely out of operation. A change in direction of rotation of the generator requires in the regulator only a change in the position of the two stopper plugs in the oil pump. A safety valve is provided to relieve the pump from excessive pressure. All electrical connections of the regulator are made to stationary binding posts and there are no sparking contacts. As the case is dust proof, destructive grit resulting from sand papering the commutator cannot affect the regulator, and as it is partly full of oil at all times the bearing surfaces are thoroughly lubricated and wear is consequently reduced. Thus, thorough protection of the mechanism and careful provision for its lubrication increase the reliability of the regulator, and it will remain longer in proper adjustment and require far less repair than one exposed to dust and dirt.

The Form 2 regulator has been built so that it may be substituted for the Form 1 regulator (operated by magnetic clutches) either with a new rheostat or fitted to the old rheostat.

The Platinum Industry in Russia.

Mr. W. R. Holloway, the United States Consul General at St. Petersburg, includes in his report the following details of the platinum industry of Russia: The Urals have been, up to the present, practically the only source from which platinum has been procured for the international market. Its part formed over 95 per cent. in the total production of that precious metal. A small group of platinum mines, concentrated in the Verkhotursk district of the Government of Perm, includes about 70 separate mines, of which only 40 are being worked, and the remaining 30 are either inactive or under investigation. During 1897, the production of platinum amounted to about six tons. There are only seven great platinum enterprises in the Urals, of which five have been purchased by foreigners. When one considers that no new veins of platinum have been discovered during late years, that those now existing will soon be exhausted, and that no other platinum mines have been found in the Urals, one must come to the conclusion that the Russians have let out of their hands an important industry, and the only one which enjoyed a monopoly of the world's supply.

Over the St. Bernard.

An English company is trying to secure a concession to build an electric wire-rope railway from Aosta, in Italy, over the great St. Bernard to Martigny in the Rhone Valley.

RUSSIA. The Czar is reported to have authorized the building of an electric road from Warsaw, via Lodz and Kalisz to Skalmierzyce, making various important connections and to be ready in 1900.

NASSAU RAILROAD. Brooklyn is said to have a weather prophet of its own so as to be ready for storms that might interfere with its trolleys. The Government predictions are not trustworthy enough.

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"Bliss" Presses for the Manufacture of Armature Discs.

THE requirements of armature work for electric motors and dynamos have led to the construction of presses which differ in essential points from those used for other styles of sheet metal work, and we take pleasure in presenting to our readers several of these presses, which will be of particular interest as representing the types of many of the machines used in the manufacture of armature discs. The press shown in Fig. 1 is especially designed for simultaneously cutting the inside and outside of plain rings, with or without key notches, such as is shown on the floor in the illustration. It will do up to 21 in. diameter for work of this class. The rings or discs, as they come from this press, are ready for notching by means of machine shown in Fig. 6. The press may be also used for simultaneously punching the notches on discs up to about 10 in. outside diameter. The press is supplied with an automatic knockout, as will be seen from the cut. The machine in Fig. 2 is used for cutting round blanks or sections up to the size of opening in bed (16 in. x 22 in.). This press is also built with an overhanging frame and is used for the same class of work, but is preferred by many on account of its admitting the metal in sidewise.

The "Stiles" double crank power press, Fig. 3, is extensively used in the manufacture of armature sections. It embodies a number of special features which have not heretofore been used in connection with presses of this class. It is made in a number of sizes, weighing from 1,600 to 25,000 pounds. It is sometimes supplied with a positive knockout for punch and die, making the press specially adapted for cutting the entire armature disc (outside, inside and notches) in one blow, and for that class of work is employed on discs up to 11 or 12 inches in diameter. Beyond that size it is usually furnished with back gearing, and sometimes with a body of cast steel instead of cast-iron. It may, however, also be used for plain rings, and in that case is designed to take in diameters up to 24 inches. It is also a useful machine for cutting the smaller sections for armatures for large generators, in which case the outside of the sections and holes in same are mostly punched simultaneously. Figs. 4 and 5 illustrate two types of "Bliss" double crank presses, which are largely used for cutting armature sections. They are made in a large number of sizes, weighing from 2,600 to 37,000 pounds.

The "Bliss" automatic notching press is illustrated in Fig. 6. This machine is of entirely new design and offers several important advantages over other machines of this class. It is made in three sizes, with or without clamping arm, weighing from 1,500 to 3,000 pounds, and is adapted for automatically notching with great accuracy discs of from 3 to 60 inches in diameter.

The shear shown in Fig. 7 is specially designed for cutting the inside and outside of armature discs. The machine is very carefully built throughout, so as to meet the demand for a tool of greater accuracy and strength than the ordinary cheaply built shears on the market. The angular position of the lower cutter permits of making as clean a cut on the inside as on the outside of the discs. It is made in a number of sizes and will cut circles from 6 inches to 72 inches in diameter.

The "Stiles" power punching press, shown in Fig. 8, is also much used for electrical work, the range of work for which it is adapted being nearly every kind of blank cutting, punching, perforating, forming, bending, etc.

If we have failed to make ourselves perfectly clear in regard to any of these machines, the Bliss Co., Brooklyn, N. Y., will take pleasure in giving any further information which may be required. We would state that this company has had almost unlimited experience in the manufacture of tools for producing armature discs and other sheet metal electrical parts and fittings. They will be much pleased to correspond with any one who is interested.

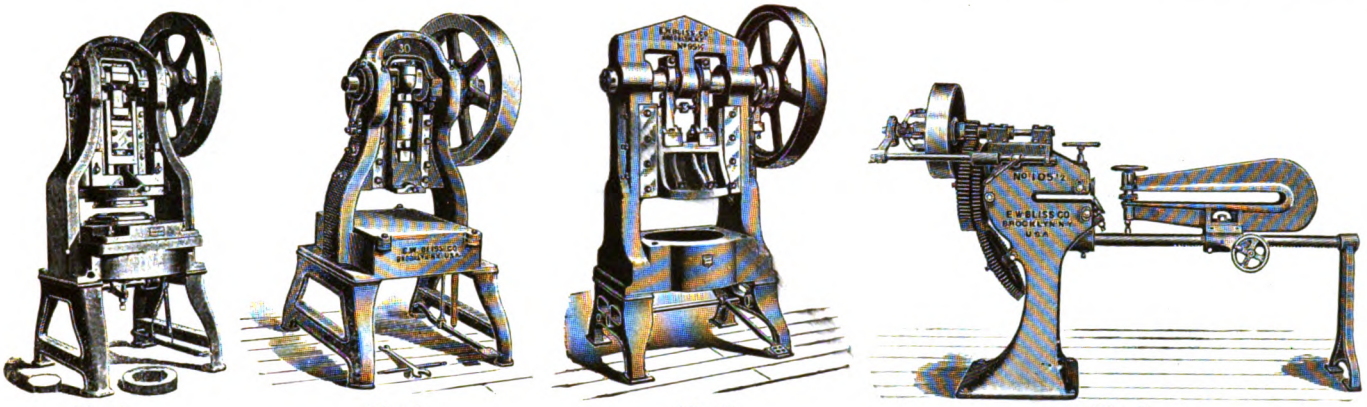

Fig. 1. Fig. 2. Fig. 3. Fig. 7.

BLISS MACHINES USED IN THE MANUFACTURE OF ARMATURE DISCS.

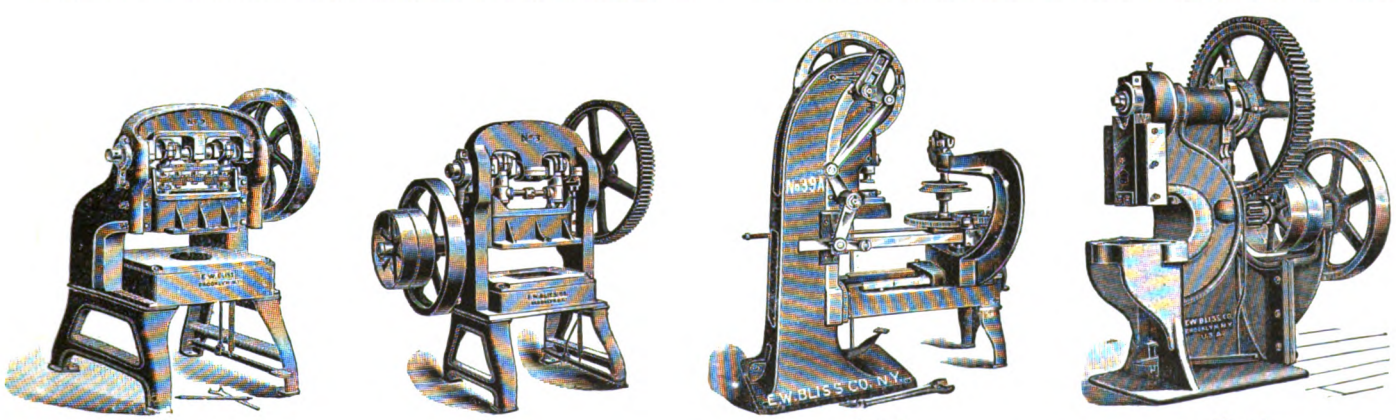

Fig. 4. Fig. 5. Fig. 6. Fig. 8.

BLISS MACHINES USED IN THE MANUFACTURE OF ARMATURE DISCS.

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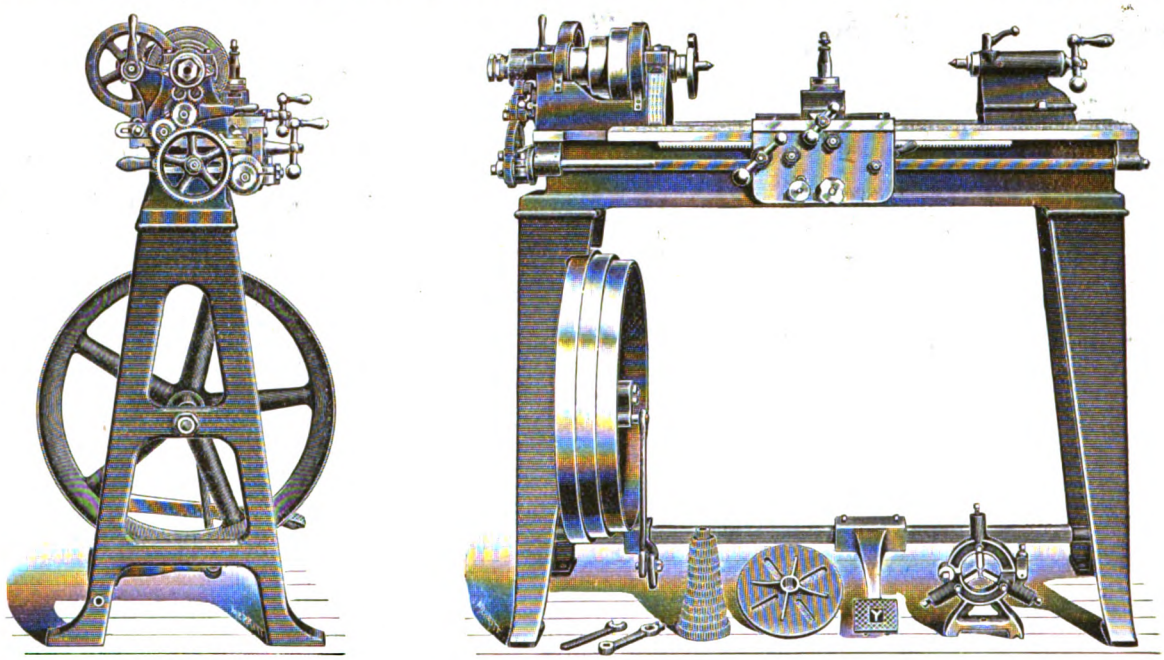
The New W. C. Young 10-Inch Lathe.

THE accompanying illustrations show the front and end view of a 10-inch screw cutting lathe that has just been brought out by the W. C. Young Mfg. Co., Worcester, Mass. It is made from the designs of Mr. Young, and possesses features that will be appreciated by electricians and bicycle repairers and all who are engaged in experimental and laboratory work.

All the working parts are exceptionally heavy and are carefully fitted. The hollow head spindle is forged from 1 7-16-inch crucible steel and runs in heavy bronze boxes. The cone has three steps for 1½-inch belt and the back gear ratio is 8 to 1. This gives six speeds, which increase in geometrical progression. The lathe is furnished with plain rest and automatic cross-feed and the tool is adjusted by screw collars on the tool post. The compound rest is of entirely new design, and is to be furnished only as an extra attachment. The friction feeds have a range of from 32 to 110 to the inch. Gears are furnished to cut a large range of threads, covering all machine screw threads from 5 to 72, including 11½ pipe thread. A special lead screw and gearing can also be furnished for cutting metric threads. The back and feed gears are covered to prevent injury to the hands or belt.



THE W. C. YOUNG LATHE.

The lathe is built with an improved foot motion, which reduces friction to the minimum. A friction countershaft is furnished in place of the foot motion, if desired, at the same price. A rack is provided for holding the change gears, centre rest and face plates when not in use. The jaws of the centre rest are of hardened steel carefully finished.

The lathe, with 4-foot bed, weighs on skids, ready for shipment, 525 pounds.

The W. C. Young Co. report that they are very busy at the present time, and are compelled to run until 9 p. m. every night in order to keep up with their orders. Inquiries are invited as to any of their machines.

OBITUARY

Robert Hemingray.

We regret to note the death of Mr. Robert Hemingray, at the age of 79, at his home, Covington, Ky., on Dec. 27. He was a pioneer glass manufacturer in the Ohio Valley region, and the name is very familiar in electrical circles.

PERSONAL

Mr. W. J. Clark.

Mr. W. J. Clark, of the General Electric Company, has accepted the position of General Manager of the Foreign Department, with headquarters in New York. In the reorganization of the foreign department, Mr. D. Mazanet, who, for five years has held the general managership and who has piloted it from its small beginnings to its present position as one of the foremost departments of the company, becomes Managing Director of the Mexican General Electric Company, with headquarters in the city of Mexico. In view of the importance of our recent foreign acquisitions and our improved relations with foreign countries, the scope of the foreign department will necessarily be greatly widened. It will have charge of all commercial relations between the General Electric Company and all countries outside the United States.

Mr. Clark's wide experience in foreign commercial matters peculiarly fits him for his new position. He has traveled through Europe, as well as in the countries to the South, and his familiarity with foreign methods and manners will stand him in good stead. His book "Commercial Cuba," recently published, is already acknowledged to be the standard authority on Cuban commercial affairs. He will be greatly missed from the Railway Department.

MR. H. H. CARR has been appointed superintendent of the Newport News Railway & Electric Co., which was recently bought by a syndicate formed by Alex. Brown & Sons, of Baltimore.

DR. LOUIS DUNCAN is consulting engineer for the Third Avenue Railroad in its plans for converting the Fifth Avenue stage line from horses to electricity. Many types of vehicle have been submitted.

MR. KLAS WEMAN, of Helsingfors, Finland, is in this country investigating the telephone service for the Russian Government, it is said, as it is the intention to take over the private system in St. Petersburg and put in a new exchange with underground wires. He is getting prices also.

PRES. A. B. CHANDLER, of the Postal Telegraph Cable Co., has been elected a director of the Erie Telegraph & Telephone Co.

MR. W. A. VAIL, State Superintendent of the Central Union Telephone Co., in Indiana, has been a visitor to New

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York the past week. He reported the conditions of things telephonic in his bailiwick as "interesting but very hopeful."

LIEUT. COMDR. S. DANA GREENE, of the General Electric Co., and late of the U. S. S. "Yankee," has been appointed naval aide on the staff of Governor Roosevelt of New York. As an old Annapolis man, and one who has seen much active service, Lieut. Comdr. Greene is a singularly happy choice for this post of honor, and the electrical community is greatly flattered by it.

MR. GARDINER C. SIMS, who was the first to offer his services to the Engineer-in-Chief of the Navy, is the last Volunteer Chief Engineer to leave the service. The U. S. S. "Vulcan" is now to go out of commission and Mr. Sims will return to civil life, where a warm welcome and abundant work awaits him.

LEGAL NOTES

Duty on Incandescent Lamps.

The Classification Board of General Appraisers, New York City, has ruled as follows: Incandescent lamps, blown glass being of chief value as a component material, imported by Knauth, Nachod & Kuhne, were assessed at 60 per cent. ad valorem and were claimed to be dutiable at 45 per cent. The protests were sustained, and the collector's decision reversed with an appropriate order of reliquidation. This order, however, is not intended to cover any goods described as "reflector lamps."

Decision as to Niagara Power in Canada.

Word comes from Toronto that the High Court has decided that the power franchise between the commissioners of Victoria Park and the Canadian Niagara Power Company is valid and in force. The facts in the case were noted in The Electrical Engineer of Dec. 29. This decision is a victory for the Canadian Niagara Power Company, and is of importance to the people of the vicinity, especially to all users of Niagara power, for under the agreement one-half of the power generated in Canada, that is, in the park, may be transmitted to the American side of the river, where it may be used to operate factories in case of a serious accident in the Niagara Falls Power Company's American plant.

An Electrolysis Damage Case.

A case to test the liability of an electric railway company for damages to the system of a water company has been heard at Peoria, Ill., before Master in Chancery Wean, of Chicago, who was appointed by Judge P. S. Grosscup. The Peoria Water Company asks for damages from the Central Railway Company for alleged injuries to its piping system, due to electricity. The result of this case will determine future action in the country by water companies. Dabney T. Maury, superintendent of the company, submitted specimens of its pipes, where electrical action had affected the pipes, rendering them useless. The evidence adduced at the hearing will be submitted to Judge Grosscup for an opinion. It is held by the plaintiff that the collapse of the Peoria water tower in 1894 was due to electricity.

Telephone President Indicted.

The Grand Jury of the District of Columbia has returned a true bill against Mr. Samuel M. Bryan, president of the Chesapeake and Potomac Telephone Company, on the charge of violating the act fixing the yearly rental of the telephones in the District of Columbia. The law which was enacted last June fixed the yearly charges at from $50 to $25, according to the number of telephones on a circuit. The company contended that the act was unconstitutional and adhered to the former rates. The matter was taken up by a Citizens' Association, and many injunctions were obtained to prevent the removal of telephones upon tender by subscribers of the amount fixed by the act. These injunctions will soon be heard before the District Court on the constitutionality of the act in question.

SOCIETY & CLUB NOTES

American Institute of Electrical Engineers.

A meeting of the Institute was held at 12 West 31st street, Wednesday evening, Dec. 28, Mr. John W. Lieb, Jr., of the Council, in the chair. A paper was read by Mr. Arthur A. Hamerschlag of the New York Trade Schools, on the "Education of Electrical Apprentices and Journeymen." It was illustrated by lantern slides, showing the work done by the electrical and other trade classes at the school. The paper was discussed by Messrs. Wetzler, Lieb, Thompson and Pope.

At the meeting of the Executive Committee in the afternoon, the following Associate Members were elected: John Allan, full partner, H. H. Kingsbury & Co., 54 Margaret street, Sydney, N. S. W. John Jacob Bellman, electrical engineer, Crocker-Wheeler Electric Co.; residence, 90 King street, New York. Robinson Crowell, electrical tester, General Electric Co.; residence, 72 Washington avenue, Schenectady, N. Y. Henry B. Dates, Professor of Electrical Engineering and Physics, Clarkson School of Technology, Potsdam, N. Y. John C. Finney, cashier, Wisconsin Trust Co., residence, 34 Prospect avenue, Milwaukee, Wis. Wm. N. Gladson, Professor of Electrical Engineering, Arkansas Industrial University, Fayetteville, Ark. Leo Walter Hildburgh, student, Columbia University; residence, 1 West 30th street, New York. William B. Hodge, electrical engineer, Elmer G. Willyoung & Co.; residence, 707 Spruce street, Philadelphia, Pa. Saitara Oi, Chief Engineer to the Bureau of Telegraphs, The Ministry of Communications, 16 Kamitomisakacho, Koishikawa, Tokyo, Japan. Francis E. Tyng, manager, Eastern Engineering Co., New York; residence, Cranford, N. J. Arthur J. Wood, associate editor, "Railroad Gazette," 32 Park Place, New York; residence, 162 Washington Park, Brooklyn, N. Y.

REPORTS OF COMPANIES

Sale of the Home Telephone Co., Baltimore, Md.

A special dispatch from Baltimore, of Dec. 28, says: Judge Wyckes, in the Circuit Court, has signed a decree for the sale of the Home Telephone and Telegraph Co.'s property at Baltimore. It provides that the sale shall take place after three weeks' notice by advertisement, and that no bids less than $125,000 shall be received. The operation of the decree was suspended by the Court until Jan. 2, by which time, it is said, arrangements for the reorganization of the company may be made by their stockholders. The upset price of $125,000 named in the decree, it is said, exceeds the company's liabilities, including its bonded indebtedness, with interest, of $90,000.

General Electric Plans for South America.

The announcement of the incorporation of the South American General Electric Supply Co., means, it is said, the extension of the foreign policy of the General Electric Company. The directors of the new company are S. D. Greene, H. W. Darling, D. Mazanet, J. R. Lovejoy and M. F. Westover.

Mr. Mazanet, late manager of the foreign department of the General Electric Co., when seen at his office in this city last week, said: "The directors of the company are all department managers of the General Electric Co., and the organization of the new concern means that the General Electric Co. is to control more distinctively its foreign agencies, or rather it is to do away with foreign agencies altogether, and is to be represented in the foreign field direct. The object of the company is to sell electrical supplies manufactured by our company to the Argentine Republic, Uruguay, Paraguay, Chili and Bolivia, in connection with friendly companies already established in these countries.

"It is following out the plan of the South African General

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Electric Co. and the absorption of the Mexican Electric Co. The capitalization of the new company of $50,000 is purely nominal, as we expect to do a much larger business in South America than this. During the year just ending our aggregate business with the Argentine Republic exceeded $600,000."

THE STOCK MARKET.

"Still Betters What Is Done."

During 1898 there was a rapid revival of all industries, and especially of electrical, so that they may be described as entering upon the new year firmly and solidly. This is true alike of the manufacturing and the local interests throughout tne country. The conditions of 1898-9 are discussed elsewhere in this issue, and it will be seen that the dominant note is one of hopefulness, expansion and advance. It would be impossible to strike any other in view of the improvement in the old year and the hopes that the new year holds out. It is a singular but not incomprehensible fact that in the gains for 1898 on the New York Stock Exchange, the two local securities that topped all others were New York Edison and Metropolitan Street Railway, one gaining over $70 per share and the other over $60. For electricity that is doing pretty well.

The last financial week of the year was short, but all stocks were very active. Of Western Union, 8,456 shares were sold, closing at 93¼. General Electric was strong, and on dealings in 9,294 shares, sold up to 95¾. New York Edison closed at 194, and Metropolitan Street Railway at 192. In Boston, American Bell Telephone was steady around 279, and West End Railway at 89.

In metals, the markets continue strong. Copper, New York, was 12.90 cents. Heavy steel rail, Eastern mill, was quoted at $17.50.

TRADE NOTES AND NOVELTIES

The Eureka Electric Co.'s Express Telepone Switchboard.

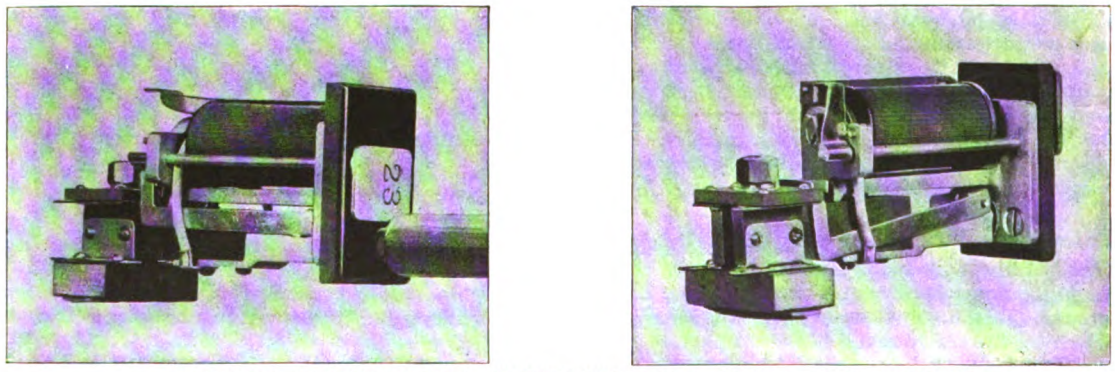
SOME remarkable claims as to efficiency, economy and general superiority of apparatus are made by the Eureka Electric Company, of 157 South Canal street, Chicago, who have been placing their apparatus in large quantities in different parts of the country. We describe some of their productions herewith, and illustrate the drop. Illustrations of the other apparatus will be found in the advertisement.

In the Eureka express switchboard, each drop and jack is self contained, and can be removed and replaced in less than 30 seconds, by novice or expert, without disturbing the night bell circuit, or a single line connection, or using a tool. The clearout drop and operator's cam is also self-contained and removable. The boards are built in 100 line dust proof frames, beautifully finished in quarter sawed oak, and so arranged that, by removing the moulding from one side of the cabinet, additional cabinets can be placed side by side, thereby increasing the capacity of an exchange 100 numbers at a time, and the cabinets always showing a finished appearance, without disturbing the first section installed, or if larger frames are desired the same can be furnished. Each 100 line metallic board is equipped with a full complement of operator's set, comprising the following: Ten pairs of strong, heavy plugs and reinforced cords. These cords are so manufactured that they take a set screw, clamping them into the plug handles in such a way that there is no pull upon the tinsel of the cords, and this arrangement does its work so efficiently that it is impossible to pull a cord from a plug in service. These cords allow an operator to kink the cord closely up to the plug, without fear or danger of breaking its connections. Over each set of plugs is a self-contained clearout drop and listening and ringing cam. This cam is of such construction that it is pleasant to operate, and it also controls the ringing on either cord and the cutting in and out of the operator's set. With each operator set is included a hand generator warranted to ring through a resistance of from 35 to 40 thousand ohms, and having heavy quantity output. Thus, it can be adapted for ringing either series bells on short lines, also those of high resistance as well, where it is desired to ring a maximum number of bridge bells over a long bridge line.

The Eureka long distance amplifying solid back transmitter with its latest and improved construction, possesses a metal solid back, which does not allow of any vibratory action whatsoever. The transmitter is suspended from a neat arm and is adjustable, as to height and distance, from the case of the board. A long distance silk wound induction coil is furnished, with fibre rubber heads, screw and washer terminals and soldered connections, also a night alarm bell, gravity batteries for transmitter, and night bell circuits, compound double pole receiver and spring head band, organ stop switches for changing the ringing circuit from hand to power generator, also to cut on and off the night bell circuits. The plugs and cords are easy of access. The total width of the board is 19 inches.

As to the rapid operation of this board, the fact that the Eureka Company have equipped one exchange using 300 numbers, operated by one operator, is evident proof of its rapidity in operation. They furnish these boards in any size cabinet desired. The 100 capacity size is standard, in which they can mount any number of drops desired. Their metallic boards are built either for common return, ground or complete metallic circuits, for use with either series or bridging telephones, or a combination of both. For large exchanges they provide a transfer system.

In operation, in place of the drops falling upon the board, the Eureka Express drops sidewise, as shown by the cuts herewith, which will convey clearly the idea of the method of falling. Upon ordinary self restoring drop boards, should the frame be jarred, or should the operator accidently strike the face of the board with the tip of a plug, in place of entering the jack as intended, she is liable by accident to jar the board, drop the shutters and be unable to determine whether the calls were actual or only apparent. In the Eureka Express this cannot happen, for the action of the drops is such that they are held so rigid and firm, in their position, and the magnet must be magnetized



EUREKA ELECTRIC CO.'S "SIDEWISE" DROP, FRONT AND BACK VIEW.

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before it will actuate the armature and release the drop so that it may fall.

After a call has been made and the drop has fallen, the operator picks a plug, and the same movement, when she inserts the plug into the jack, also throws the operator's set into connection with the subscriber making the call. In consequence, the operator does not have to move the listening cam to complete her circuit, as that is established immediately by the insertion of the plug. After learning the number desired, she takes the mate of the plug used and inserts it in the jack of the drop to which connection is desired. This same movement establishes the circuit and by turning the operator's cam to the right rings the subscriber wanted without, in any way, ringing back into the first subscriber's ear.

After the above operation, by a slight movement of the operator's cam to the left, this throws the operator's set out of the circuit. The insertion of the plugs cuts out the main line drops and cuts in a high wound bridged automatic restore clearout drop. At any time, should the operator desire to learn if the lines are busy, a slight movement on the switching circuit will throw her in circuit. When disconnection is desired, the ring off from either side will drop the clearout drop of the circuit, and the operator now restores her operator's cam to its normal position, which automatically mechanically restores the ring off drop. Each ring off is self contained in a hard rubber case, with its own operator's cam, a new special feature, and is easily accessible at any time.

This Eureka Express board is perfect in all details of electrical and mechanical construction. The quality of the material used in its construction, is of the highest grade attainable, and the mechanical accuracy and finish, as well as the durability, of each component part gives the apparatus long life under the most severe use. It is composed of a few parts, and contains only one simple, strong, German silver spring, strongly built and is guaranteed to withstand years of wear and service.

The plugs are strong and have no springs whatsoever, and care has been taken that all the working parts of the drops are built so that they may not easily get out of order. In the removal of a drop from the board, for inspection, and the cleaning thereof, no tools are necessary, as the loosening of one thumb nut releases the jack and drop complete from the front of the board. The connections to the line points are not made by any spring connections, but by a firm positive contact and locking device. The night bell is positive in its action, and connection is firmly made in a way that cannot fail to work in every instance.

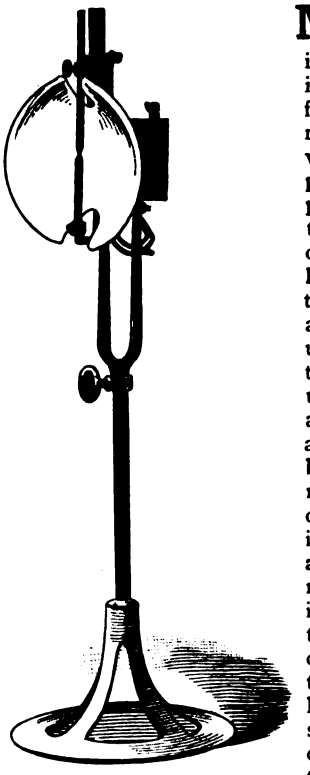
All windings of the coils are with silk covered wire throughout, and hard rubber is provided in all cases for insulation. The drops are very sensitive to the influence of magneto currents. The front rubber pieces of the drops are highly finished and the entire workmanship and material are as fine as can be made. The Eureka Company will cheerfully furnish any additional information that may be desired, upon this board.

Some Foreign Business of the Westinghouse Electric and Mfg. Co.

The foreign business of the Westinghouse Electric & Mfg. Co. is now larger than it has ever been before in the history of that company and at the present time there are orders for electrical machinery from abroad, in the factory at East Pittsburg, amounting to hundreds of thousands of dollars.

The London office of the company has recently secured a number of important contracts for electric railway apparatus from some of the larger cities in England, among which the following may be mentioned: For the Hull Tramway Corporation, 92 electric railway motors to equip 45 cars and one track sweeper; for the Halifax Tramway Corporation 12 motors to equip 6 cars; for the Bradford Tramway Company 48 motors to equip 24 cars; for the city of Norwich 80 motors to equip 40 electric cars and four electric generators to be installed in the power house of the Norwich Tramway Corporation to generate the electric current for the operation of these cars; for the city of Coventry—the great bicycle headquarters of England—20 motors to equip 10 cars, and two power generators; and for the well-known seaport city of Plymouth 10 motors and two power generators are being manufactured for the operation of the local tramways. This makes a total of 262 electric railway motors and eight generators now under construction for England, which is the best evidence of the fact that American manufacture is constantly gaining favor in Europe and owing to the better class of material and workmanship is often used in preference to home productions.

Chas. J. Bogue's Projectors and Focusing Lamps.



MR. CHAS. J. BOGUE, 213-215 Centre st., New York, is issuing a number of new pamphlets illustrating his line of projectors and focusing lamps, in which he has recently introduced many new and valuable improvements. The line of projectors is most complete, comprising all sizes from the 8-inch taking 10 amperes, giving a beam of light effective at a distance of half a mile up to 32-inch diameter, taking 10 amperes, giving a beam a beam six miles and over. The utmost care and attention is given to the selection of the mirrors used in these projectors. They are imported especially for this apparatus, and are of the very best quality made. Two types of mirrors are used and may be ordered, either the parabolic, which is the same as used in the English and French navies, or the Mangin mirror. When the beam of light is required to spread laterally only the depth remaining the same, a divergent lens is supplied attached to the front door. This lens is largely used by all navies. Mr. Bogue's system of controlling the motions of the lamp when at a distance from the operator, is simple and efficient. The apparatus can be placed on the top of the pilot house, and the pilot has complete control of the light.

The automatic focusing lamps provide for the carbons feeding horizontally, and the arc is in correct focus for the mirror without the slightest variation. Suitable arrangements are provided to enable the operator to spread or contract the beam as occasion requires. The apparatus is made in various styles, in polished brass or in aluminum or in japanned iron, all having copper doors and trimmings; and in any height of standard to suit requirements. The same automatic focusing lamp mounted on a telescopic stand and fitted with a shade is in great demand by photo-engravers for all kinds of studio and process work, photographic and blue printing and for all kinds of theatrical stage scenic effects. The lamp works equally well on either direct or alternating circuit.

The third type of lamp to complete this line is the hand feed lamp for either alternating and direct current, and is also largely used for photographic and blue printing, and for stereopticons, magic lanterns and any other kind of projection; and for theatrical scenic effects, there are supplied balcony reflectors, lens box, chasers, spot lights, olivette boxes, etc.

Mr. Bogue has a large shop fitted with the highest class machinery and fully equipped to handle any contracts, for complete marine electrical outfits, dynamos and motors and repair work generally, and has had long and varied experience in lamp construction work.

Gordon Battery Co., New York.

We are informed from a reliable source that the business of the Gordon Battery Co. is rapidly increasing, and friends of the company will be pleased to hear that they will declare immediately a semi-annual dividend of four per cent. on the preferred stock from the net earnings of the six months ending January 1, 1899.

Gordon cells are fast being introduced into the telephone field and fire alarm service of the country. A majority of the railroads have adopted the Gordon cell for the operation of signals, and thousands are daily in use.

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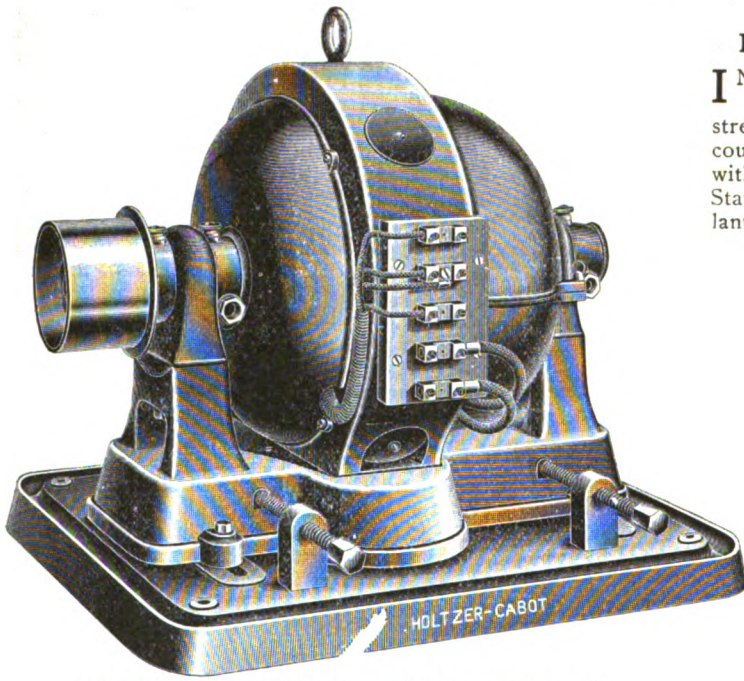
Holtzer-Cabot Electric Company's Multipolar Dynamos and Motors.

IN designing a new line of multipolar dynamos and motors, it has been the object of the Holtzer-Cabot Electric Company, Boston (Brookline), Mass., to produce a machine, simple, efficient and at the same time pleasing to the eye, no expense having been spared in the use of the best of material and workmanship. By adopting the form of machine shown herewith, they have been able to attain slower speed and at the same time higher efficiency than has been possible with the best form of bipolar machines.

They have combined with these machines a housing desirable for motors located in dusty places; a front section of this is detachable by loosening two thumb screws. This is distinctly new and claimed to be far superior to the hand hole methods generally used.

The frames are constructed of soft iron combined with steel magnet cores, making a combination superior to any other. The field coils are form wound, easily removable in case of accident. The pedestals and bearings are removable, allowing the armatures to be taken out without disconnecting the machine. All bearings are self-oiling and self-aligning, easily removable, and made of the best phosphor bronze.

In constructing the armatures most manufacturers mount the discs directly on the shaft, and for a machine of any size



HOLTZER-CABOT TYPE M. P. MOTOR, ENCLOSED.

there is very little ventilation; and with this construction, combined with a few slots as is generally used, the armature has often proved very defective. To overcome this, the company use a larger armature, a larger number of slots and mount the discs on a spider, which is provided with brass keys. With this construction, the shaft, which is made of the best crubible steel and ground to gauge, is easily taken out without disconnecting anything.

The commutators, which are built up of pure copper, are large in diameter, short, and mounted from the under side, making it impossible for the bars to loosen or buckle. The "rises" are ventilated, and should there, through negligence, be excessive heat, it would cause no loosening of connections. The armature windings are all form wound, thoroughly insulated and baked before and after assembling, which makes this part of the machine almost indestructible.

The brush holders used with these motors and dynamos, and shown in the illustration, ensure freedom from trouble from the commutator, as they will convey the maximum current noiselessly and with less heating than is possible with any of the box type or other forms depending on frictional contact between the carbon and metal.

The machines will in all cases carry their full rated load, or any other variation between no load and full load, without sparking and without shifting brushes. The ample contact surface and improved brush holder ensure cool running even under heavy overloads.

The full load commercial efficiency of these machines varies from 83 to 94 per cent., according to size, with a correspondingly high efficiency on light loads. They will in all cases carry their full rated load without the temperature rising in any part more than 50 degrees F. above the surrounding air, for the enclosed type, and 40 degrees for the open frames.

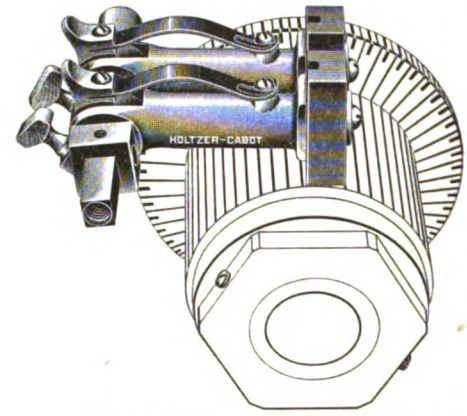
The armature is carefully balanced both before and after the coils are assembled, ensuring quiet and steady running at all speeds. A sub-base of new design has been adopted in the smaller sizes, combining sliding rails and oil pan with clamping bolts, while in the larger sizes, independent sliding rails are used.

For elevator and other work of a similar character, these motors are so wound that they will start under a heavy overload without any excessive operating current. This is a decided advantage, when it is considered that many motors require double the operating current to start them.

The dynamos and motors are made in a large number of sizes and of greatly varying capacity, all of which are fully explained in Bulletins 101 and 102, lately issued by the company. These excellent bulletins will be sent to anyone on application.

Electrical Magic Lantern Work in America.

IN an interview with Mr. Herbert J. Riley, of the firm of Riley Brothers, magic lantern outfitters, 116 Beekman street, a few days ago, he said in effect: "Since arriving in this country some three years ago I have been very much impressed with the rapid strides electricity has taken in the United States, especially in my own line, that connected with the optical lantern. It is safe to say that six to seven years ago there were



HOLTZER-CABOT BRUSH HOLDER.

not more than six arc lamps running in connection with the stereopticon throughout the whole of England, and our firm, although one of the largest dealers in these goods, was never asked for a light of this kind. About five years ago we did introduce a 250 c. p. incandescent bulb for use in the magic lantern, but would you believe it, although advertised and illustrated in our catalogues for two years, we never sold one. You will naturally ask the question, "Why?" This is easily explained, as you know soon after the invention of the arc lamp London took the matter up and lighted its streets with electricity, but finding the system then more expensive than gas, it was replaced by the latter, thus the smaller cities were discouraged, and it was a long time before electricity was to be obtained in the majority of our towns and cities.

"Bradford and Leeds were two of the first to put up a plant, and, of course, we followed suit with lamps to light up the stereopticon. Since coming to this country, however, we have made a special study of this kind of light for the stereopticon, and have been very successful in introducing two patterns of hand feed lamps which run equally well on either alternating or direct current. Of these we have sold an enormous quantity and are supplying the trade as well as retail customers. Our

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carbon holder is (as you know) simplicity itself, allowing the shifting of same at any time without the inconvenience and annoyance of handling a red hot screw.

"As to our adjustable resistance suitable for any current, we get nothing but praise for this piece of apparatus from every one; it is almost an impossibility to burn it out. It is made of the very best Krupp wire and in such a form that it is light and portable and takes up very little space indeed.

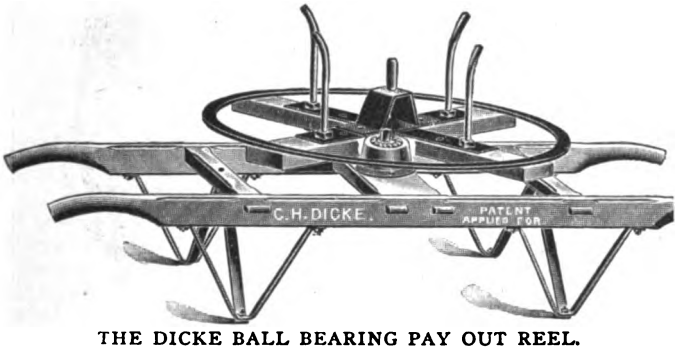
"When it comes to automatic lamps, we make two kinds; one with the scissors pattern feed, the other with the direct vertical feed, the latter being the best for photo-engraving purposes. These are the lamps which were used on election night to throw up the returns for the New York 'Journal,' 'Times,' and 'Tribune.'

"Our kineoptoscope, or moving picture machine, is selling better than ever since the price was reduced to $75, and our customers tell us it is the best and steadiest machine on the market. In about a week we expect to put on exhibition in New York an apparatus which, with our Lawson saturator will do away with cylinders or gas tanks altogether, the oxygen being automatically produced as the lecture proceeds. The apparatus is simple and efficient, and will run any length of time desired. This is going to revolutionize lantern operating, and is already giving us a great deal of work answering letters respecting the working of same. We are preparing for a big demand, and are booking orders in rotation to be filled in the same manner when we receive the machines from abroad.

"We have also made a special effort to get the trade of slide making from prints and engravings for lecturers, and have been very successful in obtaining work from some of the foremost lecturers of the day. We take special pains with all scientific subjects, and aim at a pure white ground and black outlines as essential in a diagram or outline drawing, and we are not afraid of competing with anybody in this kind of work. We have just published our new catalogue of 244 pages, which we shall be glad to send to any of your readers, together with our hire and war lists, who are interested in these goods."

The Dicke Ball Bearing Pay Out Reel.

THE Dicke reel is the only one of its kind manufactured. The novel and valuable feature is the method of suporting the circular platform upon which the wire is placed. In the accompanying illustration, two of the cross-arms of the reel are cut away so as to give a good view of the truncated cone, on top of which can be seen a number of small balls. The reel revolves upon these balls, reducing the friction to a minimum. In practical work, the friction is inappreciable, and whether the load be heavy or light, there seems to be no increase necessary in the effort to operate the reel.



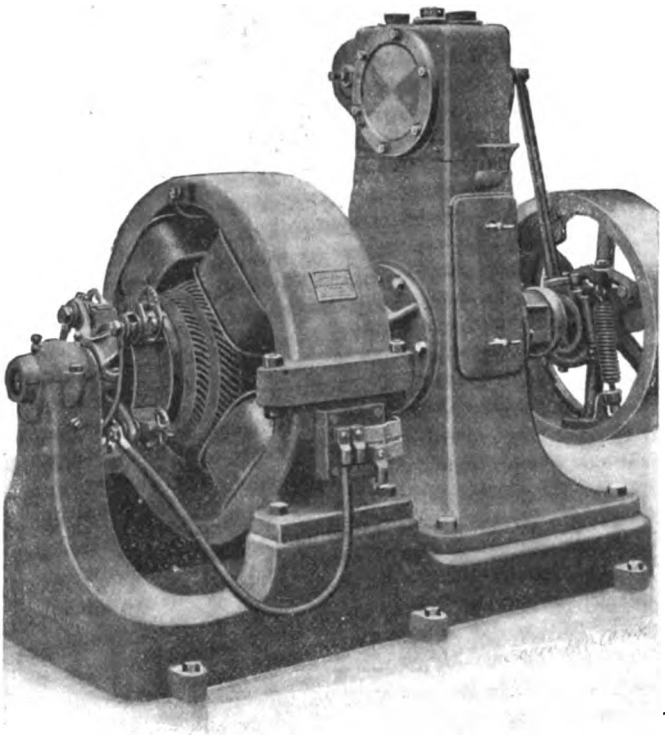
THE DICKE BALL BEARING PAY OUT REEL.

The reel is manufactured out of the best white oak; is strongly mortised, ironed and bolted. The balls and bearings are made of tempered steel and will stand much use. The Western Electric Company, of New York and Chicago, are the exclusive agents for the sale of this reel in the United States.

JOHN KAMMER CO., 176-178 Indiana street, Chicago, report that their "New Rival" incandescent lamp recently announced in The Electrical Engineer is meeting with instantaneous and unbounded success in all branches of the trade, and that business coming in somewhat livelier than anticipated, they are having some difficulty in keeping up with orders.

E. G. Bernard Direct Connected Marine Set.

WE illustrate herewith a type of plant which has found favor among the officers of the Navy Department, and has been installed in some of the smaller vessels of the navy. The dynamo is direct-connected, multipolar, and manufactured by the E. G. Bernard Company, Troy, N. Y., and the outfit is similar to the one installed by it on the United States steamer "Mangrove," and the one more recently installed on the U. S. Coast Survey steamer "Blake." The officers of the "Blake," it is stated, are very much pleased with the plant, which operates so smoothly that a person standing 10 feet away from the engine, when it is running, can hear no noise from it. The E. G. Bernard Company has just started installing a similar plant on the coast survey steamer "Pathfinder," which the Government is building to send to Alaska. These two plants are thoroughly up-to-date in design, and complete in every respect. They include searchlight and other modern appliances, such as electric ventilating fans for the ward room, staterooms and cabins.



E. G. BERNARD DIRECT CONNECTED MARINE SET.

The Bernard Co. states that it secured the contract for these plants simply through the satisfactory results obtained on the "Mangrove" and "Vixen." The dynamo runs at 550 r. p. m. It is of the four-pole type, the armature and commutator having a large radiating surface, which keeps the temperature down to an exceedingly low degree. The engine and dynamo base, including the outboard bearing, is one casting.

Aluminium Wire for the Far West.

The Pittsburgh Reduction Company, of Pittsburgh, manufacturers of pure aluminum, with works at New Kensington, Pa., and Niagara Falls., N. Y., have received an order for aluminum for a new telegraph and telephone line to be erected in Manila, in the Philippine Islands. The order came through Saale & Co., of Yokohama, who are agents in Japan for the Pittsburgh Reduction Company. The order consists of about 25 miles of telephone wire about ⅛ inch in diameter. The line will be built through the city of Manila proper, and will connect with Cavite.

MR. EDWARD A. BRUCE, of Fitchburg, Mass., formerly with the Kimball Electric Co., has formed the firm of Bruce, Hebbard Electric Co., which will carry on operations in that city.

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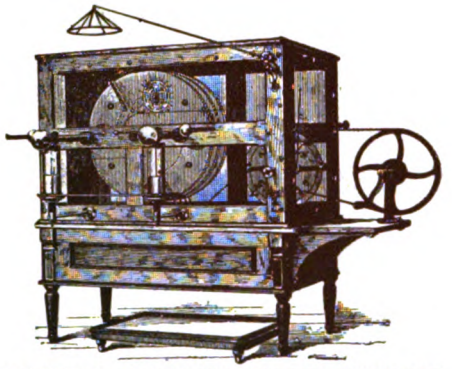
Static Machines and the X-Ray.

THE use of the static machine for the production of the X-Ray is meeting with general approval on account of the ease and quickness of manipulation. While the cost of a large Ruhmkroff coil and of a static machine is closely approximate, the percentage of first class results is said to be largely in favor of the latter, and in more than one respect, for the danger of burning the patient during examination, the breakage of tubes, and the destruction of coils by overheating, are not incident to the use of the static machine. Static electricity, it is said, has not the physical properties of carrying foreign material into the depths of tissue so readily as the other current. Static



WAITE & BARTLETT STATIC MACHINE.

electricity gives only the high voltage with low amperage, while the other being productive of both high forces, may be an unnecessarily dangerous form of current.

The static machines manufactured by the Waite & Bartlett Manufacturing Company, of New York city, whose announcement appears in this issue, are constructed with a special adaptability for the production of the X-Rays; and in the selection of such an instrument it is of prime importance to purchase one, the mechanism of which will enable the operator to concentrate its power on given points, as well as to know that the machine will work independently of atmospheric conditions.

Wheeler Reflectors.

The Wheeler Reflector Co., of Washington street, Boston, have an enviable reputation in the home and export trade, for their reflectors adapted to all kinds of illuminants and used for all varieties of lighting. The many problems presented by questions of correct illumination have been successfully dealt with through a long series of years, and the Wheeler Co. has innumerable triumphs to which it can point in this difficult field of work. Their catalogues include reflectors of endless variety and utility, and new wants as they arise are carefully studied and met.

The Wheeler Co. report an increased volume of trade and business in 1898 over any preceding year, and in their opinion there is every indication of a prosperous business in their branch of the electrical field in 1899.

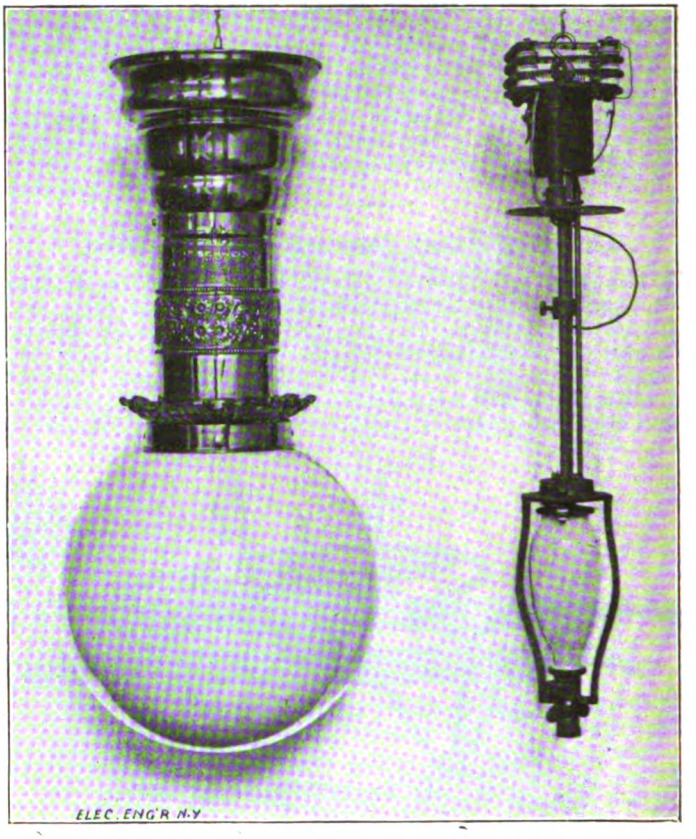
Two Complete Telephone Sets for Five Dollars.

Note was made in these pages last week as to the formation of the Russell-Tomlinson Electric Co., who have opened headquarters at 41 Cortlandt street, New York City. For some time past this company has been building telephone apparatus and doing a large private line business in New England. It has now carried out plans for the manufacture of its apparatus on a more extensive scale than ever, and it is marketing some of its specialties at prices that are simply marvelous in view of the ornate finish and mechanical excellence of the goods. Its "New Standard" telephones, for example, are wonderful for style and solidity ,and having carefully examined them ourselves, we must confess that we are deeply impressed with the skill and economy that enables the manufacturer to offer two such perfectly working telephone sets for the absurdly small sum of $5. All the parts are nickel plated, and the transmitter sections are carried compactly on the front of the box. The transmitter is of the coal grain type, with an extra metal disc to prevent any damage to the diaphragm portion by intrusive pencils or malicious fingers. The receivers are of the watch case form, very neatly and substantially made. Any ordinary form of telephone battery can be used. The "New Standard," which are loud talkers, handsome in design, small and compact, and simple in construction, are guaranteed to work perfectly on lines up to 2,000 feet or less.

At some other time we shall take the opportunity to describe and illustrate the apparatus of the company intended for divers other and special uses. For the present it will suffice to say that the Russell-Tomlinson Co. has fine references, issues an admirable illustrated catalogue, and desires to secure competent and aggressive agents.

The "Eschwei" Enclosed Arc Lamp.

A NEW enclosed arc lamp, possessing many admirable and several novel features, which reduce its working mechanism to extreme simplicity, has recently been placed on the market by the Universal Electric Pull Socket and Switch Company, 35 South William street, New York. The lamp shown closed and open in the illustrations, only measures 27 inches in length and is made in various ornamental and plain finishes to suit the taste of the purchaser. As stated above, the lamp has very few moving parts, and those which require moving are made strong, durable and simple. The operation of trimming is reduced to a minimum, the negative holder being taken out by loosening a winged screw. The inner globe need not be removed when the lamp is being trimmed, which means a great saving in time. The inner bulb is also placed in position before trimming the lamp, which is an advantage easily recognized and appreciated by central station men and arc light trimmers. The upper car-



ESCHWEI ENCLOSED ARC LAMP.

bon is supported by a clamp sliding along two rods which act as guides and also as the conducting portion of the lamp frame. They are insulated from the rest of the frame by mica. The gas check, supported on the upper portion of the negative frame, makes a ground joint which is always kept tight by its own weight. The positive carbon is controlled by a lever ring switch of very simple and novel construction, controlled and regulated by a tension spring. The clutch rod is fastened to a diaphragm of iron which prevents the jumping of the arc, as has been determined by a long series of careful experiments. A solid iron core is used, which has a very effective air valve for giving a steady movement to the feeding mechanism and preventing the breaking of the arc at starting. It also does away with dash pots. A set screw and jam nut on the diaphragm are for the

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purpose of adjusting the arc for different voltages. At the top of the lamp is the usual resistance coil neatly coiled on porcelain knobs. The current is led to the upper carbon by a flexible cord. The lamp, which is very attractive in appearance, is made for all commercial voltages and currents. It is recommended for low ceilings on account of its small height. A large number of these lamps have already been installed and have always given entire satisfaction. The members of the firm are L. Stirn, C Eschwei, M. Duklauer and G. F. Eschwei.

Meyrowitz-Vetter Electro-Medical Apparatus.

OF the various means employed in the production of the electric current, the first to be of any practical value was the liquid cell; and of all the cells with which experiments were conducted, it was finally found that the Leclanche form of battery possessed the greatest constancy. J. C. Vetter & Co. (E. B. Meyrowitz, Successor) were first to make use of these cells in the construction of their apparatus; there was, however, not only the objection that the electrolyte was a liquid, but there was also their great bulk and consequent lack of portability. When the need of a portable cell, which should also be dry (by reason of climatic and other conditions rendering it impossible to employ wet cells), made itself felt, this firm conducted a series of experiments which finally led to the production of a dry cell, which, while embodying the component parts of the Leclanche cell, together with its lasting qualities, had also the advantage of being portable. It was highly reported on at the World's Fair.

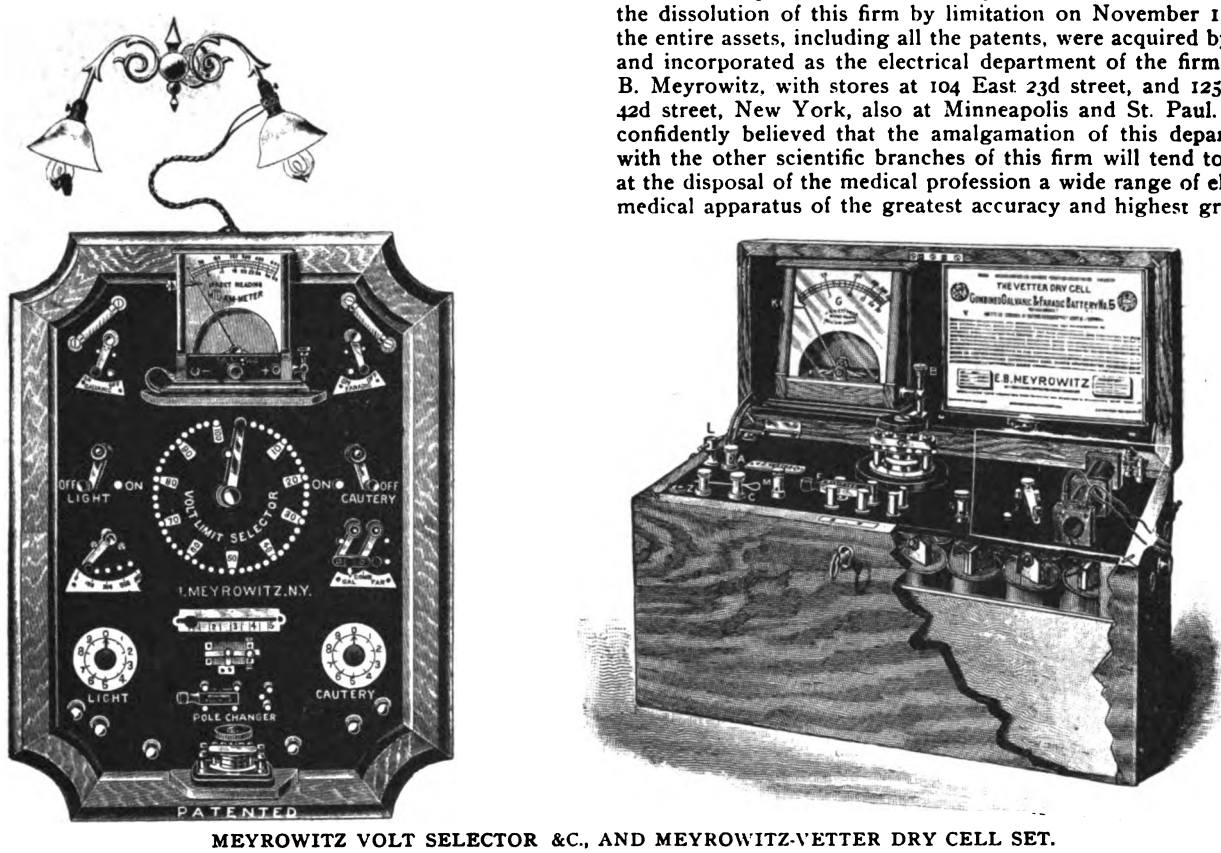
At the same time it became necessary to provide controlling devices, for the scientific application of the electric current, and the "Carbon Current Controller" and the "Standard Mil-am-Meter" were the result. These instruments are employed in all the Vetter apparatus at the present time, and are admitted to be the best of their kind in the field of electro-therapeutics.

The general introduction of the electric current into offices throughout the country (more particularly in hospitals and sanitariums where local plants are in use), has created a demand for controlling devices by which the dynamo current may be employed with equal safety and scientific accuracy. The difficulties met with in this case were the high amperage and great voltage of such a current. All the Vetter apparatus is so constructed as to absolutely limit the amperage obtainable, and also to reduce the voltage in such a manner that a current in single volts, from 1 to 110, can be obtained, and this current again be controlled so as to reduce the amperage to the fraction of a milliampere.

One of the most popular electrical devices manufactured by this firm is the Vetter current tap. This simple device will be found useful wherever the constant current is employed for lighting purposes, as it is designed to facilitate the transmission of the electric light or power to any desired point in the vicinity of the fixture, without the loss of the lamp at the point where the current is taken. As the name indicates, it "taps" the current, and does it in so simple a manner that a novice can use it without the slightest difficulty. The current tap is made in two styles, viz., parallel and series.

It is obvious that this device can be used for a variety of purposes, such as office use, factory use, in the sick room, by physicians in their office, for charging storage batteries, for charging bicycle batteries, etc. Full directions are given for all such work.

For a number of years, Mr. Meyrowitz was the managing and financial partner of the firm of J. C. Vetter & Co., and upon the dissolution of this firm by limitation on November 1, 1897, the entire assets, including all the patents, were acquired by him, and incorporated as the electrical department of the firm of E. B. Meyrowitz, with stores at 104 East 23d street, and 125 West 42d street, New York, also at Minneapolis and St. Paul. It is confidently believed that the amalgamation of this department with the other scientific branches of this firm will tend to place at the disposal of the medical profession a wide range of electro-medical apparatus of the greatest accuracy and highest grade of mechanical construction. Their newly issued illustrated 73-page catalogue will be sent free upon request.



MEYROWITZ VOLT SELECTOR &C., AND MEYROWITZ-VETTER DRY CELL SET.

Standard Underground Cable Co.

The Standard Underground Cable Company, of Pittsburg, Pa., are presenting to their friends a very neat flexible celluloid foot rule and wire gauge, and ask their friends to remember that they are on earth, while millions of feet of their cable are under it.

Electric Power in the Dixon Pencil Factory.

The Joseph Dixon Crucible Co., Jersey City, N. J., have an electric power plant running for an addition to their pencil factory. The addition is three stories, 90 feet in length and 40 feet in width. In the main factory is a Crocker-Wheeler generator which develops 22½ k. w., 250 volts and 91 amperes. The current is conveyed to the addition about 200 feet distant, where there is a 5 h. p. motor on each floor. Each motor runs at 900 revolutions per minute, taking 19 amperes, and is compound wound. Probably other motors will be put in, up to the limit of the generator.

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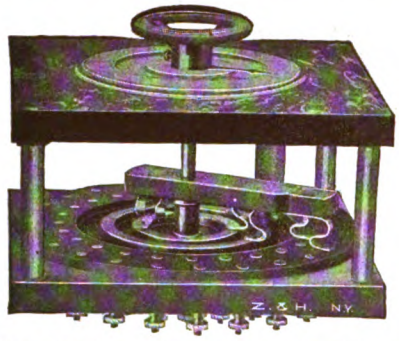
Zimdars & Hunt Voltmeter Switch.

WE illustrate herewith a voltmeter switch which is rapidly coming into favor with engineers and contractors, for switchboard use. This article, as will be seen, embodies many distinctive features. All contacts, connections, etc., are mounted on a separate slab of slate, which is located at the back of the switchboard. From this a rod passes to the front of the switchboard and has attached to it the operating handle, which carries an indicating pointer over a suitably lettered dial plate. The parts of these switches are all independently susceptible of the



ZIMDARS & HUNT VOLTMETER SWITCH.

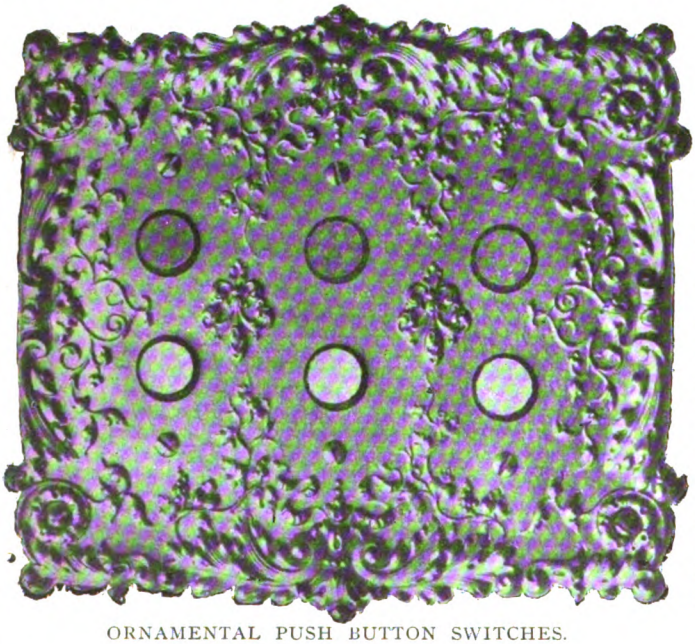
finest adjustment by nuts and screws specially provided for the purpose, before or after the switch is in place. The main points in the design are clearly shown in the illustration and need no further comment. Great attention has been given to details, and these switches do not require constant tinkering to keep them in operating condition after they have been installed.

The voltmeter switches are regularly made up to 30 circuits, and the differential galvanometer switches up to 8 pairs of circuits. They are made of greater range upon special order.

The manufacturers, Zimdars & Hunt, 127 Fifth avenue, New York, will furnish further particulars and prices upon request.

Anchor Co's Electric Hardware.

THE makers of house hardware alive to their best interests elaborate frequently on stock designs, and the evolution of these fittings from the plain face plates and door knobs of a



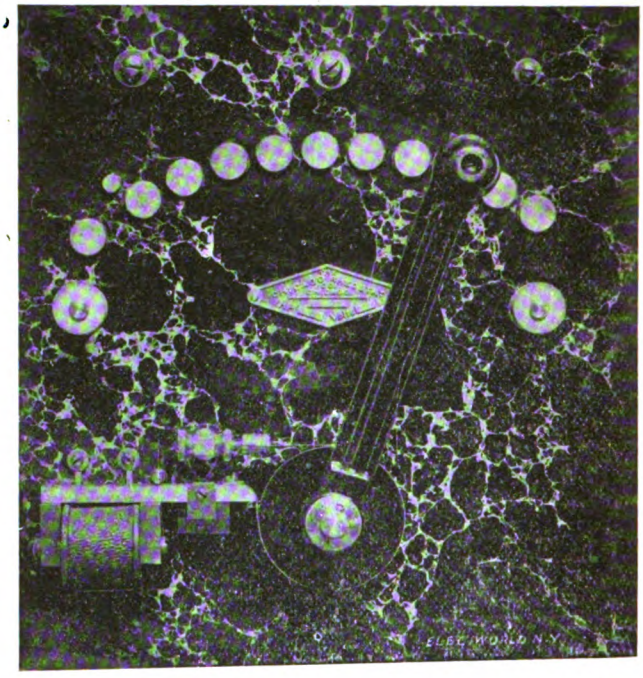
ORNAMENTAL PUSH BUTTON SWITCHES.

few years ago to the handsome designs of the present is a study not absolutely devoid of interest. Both the architect and his client in selecting building material pay considerable attention to this element, and would as soon think of putting plain hardware in a building of any pretensions as a thatched roof on a sky-scraper. Handsome residences and office buildings now require the best material, and the designs of the fittings are always in keeping with the decorations, except in one particular, the face plates for flush switches.

There is no reason now for this, as the Anchor Electric Co. have a set of designs for their push button switches made up to match the hardware of most of the prominent manufacturers of these goods. Some of these designs are shown in their catalogue, and if need be they are in a position to furnish special designs to order. This is a feature highly commendable and in keeping with the enterprise of this firm.

Chicago Rheostat Co.'s Motor Speed Regulator.

THE CHICAGO RHEOSTAT COMPANY have placed on the market a motor speed regulating rheostat having some very attractive features. The resistance is of the open coil type, arranged with great compactness, at the same time admitting of the freest ventilation. The arrangement is such that upon an



CHICAGO RHEOSTAT CO.'S MOTOR SPEED REGULATOR.

interruption of the current, the entire resistance of the box is immediately inserted and the circuit opened, this action taking place with the lever at any point.

Special attention is directed to the device for retaining the arm in position. It consists of a steel strap brake, operated by an electromagnet, and the arrangement is such that the arm is firmly held on any desired contact, and resists all efforts to jar it out of position, at the same time the arm may be readily moved across the contacts. The amount of energy required in the electromagnet is trifling and the release is positive and instantaneous. When desired the fronts are so constructed as to introduce resistance into the field circuit after having cut all resistance out of the armature circuit. The connections can also be so arranged that, with compound motors, the series coils may be cut out in one or a number of steps, as desired. In each case the automatic release action takes place from every point.

The Chicago Rheostat Company report that they have these speed regulators in use in all voltages and up to 300 amperes carrying capacity, and they have given the most perfect satisfaction in every case. An insulation resistance of one megohm is guaranteed between the resistance wire and the frame.

The well-known excellences of this company's products make it unnecessary to mention the general character of the workmanship and finish.

MR. MAXWELL S. COOLEY, former chief electrical engineer at Clinton Prison, Dannemora, N. Y., has secured the position of chief steam engineer at the Collings State Institution, Gowanda, N. Y. Mr. Robert G. Elliott has been appointed to the position vacated by Mr. Cooley.

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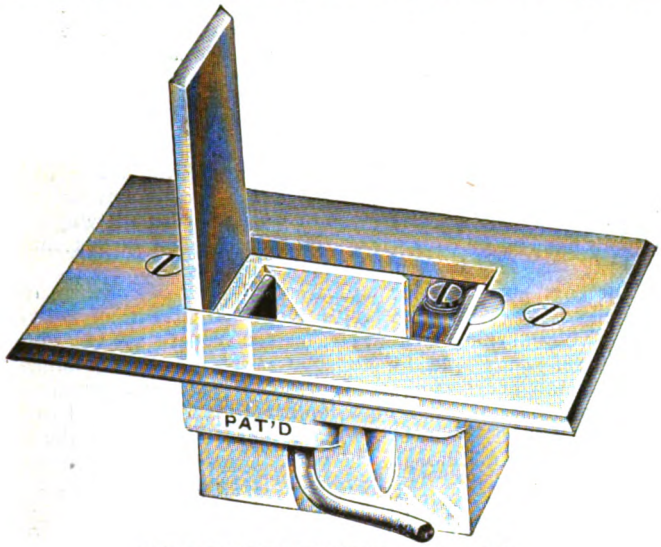
Pringle's "New Style" Receptacle.

SOME time ago, Mr. W. T. Pringle, 1026-28 Filbert street, Philadelphia, Pa., introduced the Chapman receptacle and plug, which has made its way into fame and popularity. He is now bringing out a new style, which is illustrated herewith, and which is intended to overcome the few deficiencies existing, or supposed to exist, in the old style. Contractors have often been confronted, for example, with the problem of inserting a 2¼-inch receptacle in a 2-inch partition space. The Pringle new



PRINGLE RECEPTACLE AND PLUG.

style overcomes this by being less than 1½ inches deep. Another feature of inconvenience in the old style was the trouble experienced by some people in pushing the slack wire back into the wall. This is overcome in the new style, it having face connections. There is no necessity to handle the face plate and thus perhaps spoil it while connecting it, as the plate can be removed, and after the wiring is all finished it can be put on, and there is a more creditable and clean looking job in the end.

Mr. Pringle states that in spite of the various improvements and general better effect, there is no advance in price.

Chicago Rheostat Co. Abroad.

The Chicago Rheostat Company report the placing of their agency for England and the Continent with the General Electric Company, Limited, of 69-88 Queen Victoria street, E. London. Mr. M. Bevis, general manager for this company, during his recent visit to this country, investigated this company's products, and has since been favoring them with large orders which has resulted in their acceptance of the agency. The General Electric Company will shortly issue a special pamphlet descriptive of the Chicago Rheostat Company's product. Inquiries and orders for these well known rheostats from European customers should be addressed to the London office.

The Chicago Rheostat Company are to be congratulated upon obtaining this excellent outlet for their product.

The "New Standard" Dry Cell.

Considering the fact that the manufacturer of the well-known "Exeter" and "Mesco" dry cells has sold over 1,250,000 of them in a period of eight years, it can be assumed with certainty that any similar product by the same maker must be reliable and durable. And with the above record as a backing, Mr. William Roche, 259 Greenwich street, New York, advertises his "New Standard" dry battery, which he claims is the strongest, quickest recuperating, most durable, and most reliable cell on the market. Already 207,000 of these cells have been sold in nine months, and they are still being disposed of at the same rate. Many of the cells were used by the U. S. Navy for use in the late war. Only the best material is used in the cells, and every cell is tested before being sent out. It is particularly adapted for electro-medical apparatus, dental surgery, gas lighting, gas or gasoline engine ignition, railroad signals, burglar alarms, in fact for all open circuit work. It is claimed that they "don't" rundown on the shelf, and "won't" flow at the top if used a little. The e. m. f. of the cell is from 1.55 to 1.65 volts, and the current from 8 to 22 amperes. It is manufactured in numerous sizes to suit the requirements of service.

Whitney Instruments of Precision.

THE Whitney Electrical Instrument Company, of Penacook, N. H., who are the manufacturers of the vest pocket voltmeter, which is illustrated in this article, are meeting with gratifying success in the sale of the instrument. The principle of construction is the well known permanent magnet form which insures a powerful and uniform magnetic field, thus giving a uniform scale throughout the entire range.

The instrument has been very favorably received by telephone and telegraph men, superintendents of fire alarm systems, as well as central station managers and manufacturers of electrical apparatus, in fact, there is hardly an individual interested in the electrical industry either directly or indirectly who does not have occasion at one time or other to use just such an instrument,

WHITNEY POCKET VOLTMETER.

and it takes up so little room that it is no trouble whatever to carry it on the person all the time. Their standard line of instruments are also growing in favor and they have received a great many exceptionally good orders within the past two months from some of the largest educational institutions in the United States and Canada. During the past few months they have made a number of important improvements in their "Portable Bridge" set and this apparatus on account of its exceptionally low price is deservedly popular with telephone men and in fact all who have occasion to use such an instrument. Their line of switchboard instruments is already well known and growing in favor every day with station men, and the company in order to maintain the reputation which they have made for themselves during the past five years are now at work on other types of instruments which they expect to commence manufacturing in the not very distant future.

THE ELECTRICAL APPLIANCE CO., Chicago, have taken the selling agency for the "Two Ball Lamp Adjuster," which is illustrated elsewhere in our pages. Great claims are made for this adjuster as to simplicity, durability, etc. There being no springs nor special mechanism used in the device, it cannot get out of order, and it is practically indestructible. It is inexpensive and at the same time ornamental and will undoubtedly very largely displace similar devices which depend upon springs and other mechanism.

MR. H. A. MAY, manufacturers' agent for electric light and railway supplies, has secured better and larger quarters in Syracuse, N. Y., by his removal to 347 West Fayette street, where his stock has been increased and where any orders relating to electrical merchandise will be filled promptly at bottom prices. He invites inquiries.

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Correspondence Instruction the World Over.

One of the most decided needs of the times has been met in a most efficient and useful manner by The Electrical Engineer Institute of Correspondence Instruction, which, having undertaken the instruction by mail of ambitious workers in the electrical field, now counts among its students, citizens of almost every civilized community on the face of the globe.

The Institute is finding particular favor in foreign countries, and it invites all who are interested in the study of electrical engineering to communicate freely with the management at the home offices, 120 Liberty street, New York, U. S. A. The Institute will send free upon request to any one interested, two of its interesting publications respectively entitled "Can I Become an Electrical Engineer?" and "The Electrical Marvels of Our Times." For copies, Dept. VI., The Electrical Engineer Institute, 120 Liberty street, New York City, should be addressed. A descriptive advertisement of the Institute can be found in this issue.

The Factory of the Standard Thermometer and Electric Company, Peabody, Mass.

THE building occupied by this company, situated on the Square in Peabody, close to the heart of the town, was built about fifty years ago by the grandfather of the principal owners of the company. It has been occupied by the Standard Thermometer and Electric Co., and by its predecessor, the Standard Thermometer Co., for the last fifteen years. All of this time the manufacture of thermometers has been prosecuted, and for the last nine years the company has been making arc lamps. The building is fifty feet by sixty, and its four stories and basement are entirely occupied by the works of the company, as well as two stories of an annex, twenty feet by forty. In the basement are the boiler and engine, the latter a 50-horse "Fitchburg." Besides these there are the blacksmith's forge and the annealing and brazing forge in one corner. There are four dynamos in the basement, purring away all the time in their own glass sided room, one a 110 volt multipolar for shop lighting and lamp testing, another an alternating dynamo, rigged up with change of speed counter in order to test out lamps of different frequencies; another is a convertible 220 volt or 550 volt machine for testing direct current lamps of these voltages; the last is a series machine for either 6.8 amperes or 10 amperes or anything between; this is used for testing and adjusting the constant current lamps.

On the other side of the basement is a line of presses and a drop hammer, where the drawn and punched work of the factory is done. There is a polishing and plating plant in the basement where the finishing of cases for the lamps and thermometers and the plating of the working parts and inside portions of the lamps is done. The plating current is supplied by another dynamo.

On the first, or ground floor, we find the office, which takes up about one-quarter of the space. The heavier lathes, drills, planer, etc., are on this floor, and the heavier work on the arc lamps is done here. Here, too, is the case making shop, where the arc lamp cases are made and the thermometer cases assembled. The cases for both thermometers and arc lamps are now made entirely at the factory, doing away with delays formerly experienced when depending upon outside shops for cases.

On the second floor the finer and lighter machines are placed, and back of these are spinning lathes, speed lathes, milling machines, turret lathes, automatic screw machinery, etc., as well as a tool makers' department where the special tools are made for the entire factory. In the annex on this floor are the japanning ovens, heated by gas and controlled by the special japanners' oven thermometers made by the company. In the annex are also a small special tool room and the room where telemeters are assembled and standardized.

On the third floor is the stock room, the shipping room, and the arc lamp testing room. The stock room is one of the busiest places in the whole shop. Here all the material is received, counted, weighed or measured, and from this room the raw material of all kinds goes out to the different workmen as called for. As each part, whether for thermometer or arc lamp, is finished, it goes back to the stock room and is held there till needed in the assembling room. Besides keeping trace of the work in progress, the stock keeper has to keep with each employee of the company a tool account. The company own all the tools used by the men and allow no one to bring any tools whatever into the factory.

The arc lamp testing room on the same floor is one of the most interesting places in the whole shop to the electrician. There are three separate switchboards in this room, one for alternating current, equipped with racks for testing open A. C. lamps and with instruments for controlling the alternating dynamo in the basement. The second board carries the controllers for the multipolar direct current dynamo in the basement, used for lighting the shop and for testing the 110 volt lamps either open or enclosed. For the testing of enclosed arc lamps there are ranges of drops into which the lamps can be connected and to which current can be run from either the A. C. board or the D. C. board at will. This diversion of current as well as the handling of the high tension currents, is done by means of the third switchboard. This board is equipped with a complete set of throw-over switches by which any of the lamps can be connected to the recording instruments or to the indicating voltmeters, ammeters or wattmeters at the will of the operator. The exact current consumption can be determined and the necessary adjustments made very readily.

The company make arc lamps for all sorts of currents, open and enclosed. They have lamps for direct currents of 110 volts to 220 volts burning in multiple, for 220 volts to 550 volts burning in series multiple, for constant current of 4 to 7 amperes, for alternating current of frequencies of from 7,200 alternations to 10,000 alternations per minute, and have to be prepared to test them all, hence the need of the multiplied apparatus in the testing room. In addition to the current generated on the premises, wires from the town plant are led into the testing room and a good many of the lamps are run on this current for continuous records and for testing. The current being of 10,000 alternations on the one hand, and 6.8 amperes of constant current on the other, the testing of these lamps can be proceeded with at times when the rest of the factory is shut down. This in rush times is a great convenience.

The lamps are first tested until they run at the required current consumption without covers, then they are cased up and run for several hours to develop any imperfections that may interfere with their good working after they leave the shop. The latest improvements in the construction of the lamps come from developments of the past few years' experience of the users of the lamps. They meet all the weak points that have been shown to exist, which as fast as discovered have been studied and overcome. The constant trying of new devices suggested for doing this is another testing room job, and more or less new lamps are always burning there.

The original "Midget" lamp was at the time of first offering several inches shorter than any other lamp on the market burning a twelve-inch carbon; this was done in it by putting the clutch directly on the carbon and doing away with the use of a carbon rod. This is now universal.

On the top, or fourth floor of the building, the assembling of lamps and thermometers is done. The parts are sent to the room from the stock room as needed, and they are put together rapidly and skilfully by the expert workmen there. On this floor the winding of magnets and solenoids is also done; the spoolers being driven by individual motors from the 110 volt lighting current; this method being adopted on account of the instantaneous speed control possible.

The factory is served by two elevators, one for freight and a small one for sending stock to and fro throughout the factory.

The long experience in the manufacture of arc lamps by the Standard Thermometer and Electric Company has given them much information regarding the art that cannot be had in the general run of shops. The generally accepted success of the old "Ward" lamp was due in no small measure to the skill used in its construction by the Standard Thermometer Company, which built them all, as well as the Kinsman and Knight lamps. The makers of the Upton lamps refer to the success of those lamps as a guarantee of the qualities of workmanship that can be expected in their products.

ALBANY, N. Y. The State is paying $48,000 a year for electric light and gas in the public buildings at Albany, its own plants being very defective. New plans are spoken of.

THE BEACON LAMP CO., New Brunswick, N. J., call attention to their series lamps for all circuits and septems.

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Wagner Apparatus in Europe.

Mr. Ferdinand Schwedtmann, general superintendent of the Wagner Electric Mfg. Company, has just returned from a European trip in connection with the business of this company. In view of the plans being made by the company for the extension of its business, it was deemed advisable that a general survey of European methods of manufacture should be made, and it was with this end in view that Mr. Schwedtmann made a trip to the leading centres of Europe. The Wagner Company is now executing some very important contracts, which will attract considerable attention, both in this country and abroad. As this work is under the engineering and manufacturing direction of Mr. Schwedtmann, his trip will have very material results.

Jewell Standard Meters.

An important announcement is made in this issue by the McIntosh Battery & Optical Co., of 521 to 531 Wabash avenue, Chicago, as to their Jewell standard meters. The concern is well known for its high grade electro-therapeutic apparatus, and is putting this line of meters on the same level of quality and efficiency, while selling it at the lowest price ever quoted for an absolutely standard instrument. The instruments are milliampere meters, millivolt meters and volt meters, and are guaranteed to be positively reliable for use in both vertical and horizontal positions. The construction is exceedingly rigid, fitting it to withstand the rough usage to which portable instruments are frequently subjected. This meter is of the d'Arsonval type, having a coil moving in the field of a permanent magnet. It is dead beat, and has uniformly spaced scale divisions and an adjustable dial, so that should the index become bent it is but the work of a moment to set it to zero.

The McIntosh Co. will be glad to send an 1899 catalogue and to receive inquiries and correspondence on the subject of these meters for general and special work.

The Orient Incandescent Lamp.

The Orient Electrical Company, of Youngstown, O., find themselves the busiest at this time that they have ever been since they engaged in the manufacture of incandescent lamps, being obliged to run overtime constantly to keep up with their orders. Some time ago this company decided to place upon the market a new lamp, and realizing that unless they could embody in this lamp all the essential features necessary to a strictly high grade lamp, that their efforts would be in vain, they went about the undertaking in a thorough and systematic manner. They first equipped their plant during the summer season of 1898, with all the latest and most improved instruments and appliances known to the lamp business. They spared neither time nor money in procuring these things, realizing that with old and imperfect equipment they could not hope to secure satisfactory results. While these changes in their factory equipment were being made, they were carrying on extensive preparations for the adoption of new processes in the manufacture of their lamps, many of which are used by no other lamp manufacturers, so that before the lamp season of 1898-9 commenced, they had completed and perfected their arrangements, and had their new lamps thoroughly tested under all the varying conditions to which they might be subjected. The fact that the company agrees to sell these lamps strictly on their merits and that the demand for them is constantly increasing, attests the fact that their new lamps are a success in the fullest sense of the word.

Proposals Asked for Turbines.

Proposals for turbines for the water power electric plant of the Lake Superior Power Co., at Sault Ste. Marie, Mich., will be received until March 1, 1899. The turbines which are required must be capable of developing in penstock units, composed of two or more turbines, with a head of 16 feet at the penstock entrance and with 391 cubic feet of water per second, 568 h. p. at the end of a shaft, which revolves 180 times per minute. The details of construction, type, size and number of the turbines are left to the bidder. The proposals are to be submitted to the Chief Engineer, Lake Superior Power Co., Sault Ste. Marie, Mich.

Rudolph Giese's Wire Brushes.

The firm of Rudolph Giese, 162-164 West 27th street, New York, is introducing into the American market an improved copper dynamo brush, manufactured out of chemically pure copper wire. The construction of these brushes is such as to allow a slight pressure of the brush on the commutator only, the brush being made out of soft, chemically pure, copper wire, very pliable. It will therefore not wear on the commutator in the least.

This brush, properly and accurately attached to the brush holder, will outlast, it is claimed, at least three of the woven wire brushes now in use. On account of its pliability the brush is excellently adapted for worn-out commutators, and one of the principal features is that the brush does not create any sparks. The brushes are manufactured in any dimension desired and sample orders are respectfully solicited.

National Automatic Telephone Co.

The National Automatic Telephone Company, with business office in Salina, Kan., and factory at 71 West Jackson Boulevard, Chicago, Ill., manufactures and sells the National Automatic switchboard and telephone, and guarantees them in every respect. The instruments are made of the best material. They are neat and handsome in appearance, all metal parts nickel-plated, and all wood highly polished. They are furnished in oak, walnut or rosewood. All necessary information regarding the building and equipment of plants, installation of cables, etc., will be gladly furnished by the company, whose aim it is to co-operate with those who do business with it. The company also furnishes to those using the National Automatic telephone (at actual cost) its special lighting arresters and cut-outs, which are superior and the best protection for the instrument. Special arrangements will be made with companies or communities now using the other systems, who desire to replace with the new. All telephone supplies are furnished by the company at lowest prices. Correspondence and investigation are solicited.

The company have a large number of testimonials from users of their apparatus and will be glad to refer parties to their customers.

Phoenix Carbon Co.'s Dry Cell.

THIS battery, which belongs to the type known as the "dry," is remarkable on account of its long life, which is due to its construction on purely scientific principles. The walls of the containing vessel are sufficiently porous to allow moisture from the atmosphere to pass through them, and a filling is used in close association with the excitant, a material capable of absorbing moisture from the atmosphere. The containing vessel may be made in the form of a cylinder or any other desired shape. The material of which it is composed is carbon, provided with vertical ribs on the outside for strength. The carbon of this vessel is of the quality commonly used for the negative elements of batteries, which, owing to its granular nature, is very porous.

Inside of the vessel is placed a gelatinous or semi-solid filling, containing an exciting material, such as sal-ammoniac, and also a material capable of absorbing moisture, such as chloride of calcium. These materials are intimately associated in the semi-solid mass so that any moisture absorbed by the chloride of calcium will be imparted to the other materials of the mixture and so maintain the entire mass in a moist condition. The positive electrode, which is a pencil of zinc, occupies an axial position in the vessel and is surrounded by the semi-solid filling. A layer of depolarizing material of any character is situated between the semi-solid filling and the carbon element, at which location it best performs its usual functions.

Since it is desirable to seal the top of the vessel, a cover is used which screws into place or interlocks with the vessel, and which is also made of carbon, but preferably harder and less porous than that of which the vessel is made. In this cover a metallic post is embedded and fitted with a suitable binding nut for a circuit terminal. The positive electrode projects centrally through the cover, being insulated from it by a porcelain bushing and provided at its outer end with binding posts.

It has been shown by actual tests, we are informed, that a battery constructed in accordance with the above description remains active for a much longer period than those types of battery which are sealed. The increased life is due to the fact that the chloride of calcium in the filling draws moisture from

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the atmosphere through the porous walls of the containing vessel and into the semi-solid mass, thereby maintaining the latter in nearly its normal and original condition. When the positive electrode is consumed, it is obvious that by means of the readily removable cover, another may be inserted, and, if necessary, the entire filling renewed, the containing vessel being retained.

This battery is the invention of Col. S. G. Booker, of the Phœnix Carbon Co., of St. Louis, one of the best known and hardest working leaders of the electrical industry. His long familiarity with all branches of electricity, and of late years particularly with the carbon art, have equipped him admirably for invention and research; while those who know his push and energy realize that having brought out a new thing he is not likely to let it rest in obscurity.

Sterling Electric Co. and the Cook Protector.

We have the following interesting item from the Sterling Electric Co., of Chicago: Frank B. Cook, of the Sterling Electric Company, Chicago, is being congratulated by his friends upon a recent decision of the Patent Office covering one of his inventions. Early in 1897 Mr. Cook brought an interference suit against a patent covering "Strong Current Protection," issued to Frank R. McBerty, of the Western Electric Company, and assigned by him to the Western Electric Company. The case has been bitterly contested by the defendants, but a decision is now rendered by the Patent Office in Mr. Cook's favor. The plaintiff was represented by Chas. C. Bulkley, of Chicago, and F. L. Middleton, of Washington; the defendants, by their regular counsel, Messrs. Barton & Brown, of Chicago. The protector in issue is the well-known "Cook" protector which has been largely used by the Bell Telephone Companies, and is now being manufactured by the Sterling Electric Company, for independent telephone companies.

Electrical Work in South Africa.

In his annual report, Consul Hollis, of Lourenco Marquez, speaking of the prospects for improvement in trade in the colony says that there is a disposition on the part of financiers of the Transvaal to invest money there. Already $250,000 have been spent by the Compagnie Générale d'Electricite, which has just completed an electric light station—the best equipped, Mr. Hollis says, that he has seen in South Africa. He continues: The buildings have all been built of hollow French brick, with iron beams and girders. Three large engines and six dynamos have been installed. All the boilers, machinery, and fittings have been supplied by the Fives-Lilles Company, of Rhone, France. Upon the iron posts that have been planted along the streets, I have, however, seen the marks of an English firm. This company has a concession for fifty years to supply electricity for light and power, and also for the sale of electric lamps and fittings. The company has already contracted with the municipal chamber to maintain six hundred 16 c. p. incandescent street lamps at an annual charge of $8,273.05 per annum. The government here, some time ago, gave a Belgian syndicate a concession of fifty years to build and operate an electric street railway. On the 5th of October, the Belgian consul here, who represents the holders of the concession, submitted the plans for the said railway to the municipal chamber, where they were approved and passed the same day. By the terms of the concession, work on the line must begin within nine months from October 5, 1898, and in nine months more the line must be completed and open for traffic. The plans provide for about 4 miles of the overhead-wire street railway system. In about a month, an engineer will arrive from Belgium to make the preliminary surveys.

Although Durban, Natal, is out of my consular jurisdiction, I do not think that it will be out of place for me to mention here that the Durban town council is about to appoint a commission of two engineers to investigate and report upon the electric street-railway systems of America and Europe, in order that they may intelligently decide upon the best system to be installed in Durban.

GRAND RAPIDS, MICH., is buying iron lighting towers from the Electric Light & Power Co. for its new city plant, at $400 apiece. They are forty in number and are offered below cost.

Packard Transformers and Incandescent Lamps.

So instructive and highly interesting are two pamphlets recently issued by the New York and Ohio Company, of Warren, Ohio, that we have been somewhat in doubt whether we would class them under catalogues or literature. They contain matter of greatest value to the student and practicing engineer, and do but incidentally advertise the company's well-known products. One of the pamphlets contains an admirable and very instructive article on "Transformers and Their Profitable Use," by Prof. Dugald C. Jackson. The author treats the subject under 28 separate subheads, some of which are: Transformers in Long-hour Stations; The Short-hour Station; Transformer Losses in General; Features to be Looked After; The Strength of Insulation; Central Stations; Antiquated Types; Keeping of Records; Mechanical Construction; Modern Transformers; Transformer Regulation; Raising the Pressure; Replacing Old Transformers; Transformers of Standard Manufacture; Core Losses, Aging of Iron; The Heating Limit; and The Profitable Use of Transformers. It is a splendid exposition of modern practice, and the Professor's final advice is: (1) Use large units; (2) use large modern units, and (3) use only the best large modern units. The article is profusely illustrated by beautiful half-tone illustrations, wood cuts, curves and diagrams and is accompanied by a number of valuable tables.

The pamphlet also contains an interesting and instructive article on "General Instructions for Testing Transformers," by Henry W. Wiswell, which abounds in valuable formulæ. Only three pages did the modesty of the company permit them to use for setting forth the merits of their own Packard model 98 transformers, but their apparatus is so well known that they can well let it stand on its own merits.

The pamphlet on "Incandescent Lamps" is equally instructive, and contains numerous beautiful wood cuts of the well-known Packard incandescent lamp of all sizes, candle power and voltages. Numerous fancy bulb, window, frosted globe, and 220 volt lamps are illustrated, as well as various bases and sockets. A fac simile of the diploma received by the company at the World's Fair in Chicago, where they won the highest award in a competitive test, is also shown.

The covers of these pamphlets are very unique and highly artistic, each one bearing an appropriate design executed in the now fashionable "poster" style. The company are to be congratulated on their liberality in bringing their goods before the public eye by means of such beautiful and instructive catalogues.

Transformer Design and Operation.

Under the above title the General Electric Company issues in compact form two important papers on the subject of electrical transformers, one written from the standpoint of the central station manager, by Mr. W. F. White, general manager of the Omaha (Neb.) Electric Light, Heat and Power Co., the other dealing intimately with the question of transformer economy. The first paper—read before the American Institute of Electrical Engineers—is the record of a long personal experience with the operation of transformers under actual commercial conditions, showing the relation of the many losses incident to the use of many small transformers to the earning capacity of the plant, and the very tangible economies realized as the result of the substitution by a few high efficiency transformers of large capacity of numerous groups of small capacity transformers. Mr. White gives examples of these economies reduced to dollars and cents. In this station an economy of $6,000 per annum in the cost of coal alone was realized as the result of the practical application of lessons drawn from his extended observation and experience.

Prof. Goldsborough's paper was read before the National Electric Light Association, and treats of transformer design from a practical standpoint. It contains many able arguments in favor of the use of high grade transformers and emphasizes the necessity of frequent tests as the only means of detecting leaks, losses and the general depreciation of transformers. He

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gives examples of manufacturers' claims belied by careful test, but instances other cases in which guarantees have been exceeded, and urges upon station managers the wisdom of keeping as vigilant a watch on the efficiency of their transforming apparatus as upon the items of operating expense and maintenance if the economical results desired are to be obtained.

To these papers the General Electric Company has added several maps showing graphically the significance of the substitution of the large transformer for numerous small ones. The pamphlet is, as usual, well printed and illustrated and should find a prominent place in the literature of every alternating current station manager. It will be sent free on application to any of the sales offices of the General Electric Company.

Iron Clad Resistance Company.

The new catalogue of rheostats, resistance plates and theatre dimmers, which has just been published by the Iron Clad Resistance Company, of Westfield, N. J., contains lists of dynamo field rheostats, motor starting and regulating rheostats, ventilating fan controllers and theatre dimmers of various types, which are so complete that a rheostat for practically every case met with in practice can be selected immediately from its pages.

The Iron Clad Resistance Company report that their sales are constantly increasing, and that the reports from their customers are most gratifying. They are continuing the policy which they set out to maintain, namely, they are allowing an ample factor of safety upon all their goods.

NEW YORK NOTES.

MUNICIPAL ELECTRIC LT. CO., of Brooklyn has removed its offices from 208 Broadway to 360 Pearl street, Brooklyn, where all communications should be addressed.

HELDERBERG, N. Y. An electric road is proposed up the fine Helderberg Mountain, to be built by the Albany, Helderberg and Schoharie Co., of which Mr. H. W. Burgett is the president. It is expected that the road will be in operation this summer.

JAMAICA, L. I. The Queens Borough Electric Light and Power Company have filed plans for a new plant at Far Rockaway, to cost $30,000. D. H. Valentine is president of the company, and it is said that former Police Commissioner John C. Sheehan and John Carroll, of Manhattan, are stockholders.

EDISON CO. OF NEW YORK. The Edison Electric Illuminating Company of New York reports for November gross earnings $286,940, an increase of $39,645; net $142,373, an increase of $9,802; surplus $124,873, an increase of $4,302. From January 1 to November 30 gross earnings were $2,711,602, an increase of $505,972; net earnings $1,134,059, an increase of $156,237; surplus $941,559, an increase of $101,737.

TWO BROOKLYN DOCTORS are now using automobiles. Dr. Zabriskie has a gasoline carriage, and Dr. Hutchinson a storage electric. The latter is costing the doctor $15 a month. His horse service used to cost him $30 for keep and shoeing, etc.

BROOKLYN, N. Y. The Kings County Electric Light Co., of Brooklyn, has ordered two 3,000 k. w. generators from the Westinghouse Electric & Manufacturing Co. to cost between $80,000 and $85,000.

MACHADO & ROLLER, 203 Broadway, have issued a very neat little calendar to their friends and customers.

THE UNITED GAS IMPROVEMENT CO., of Gloversville, N. Y., are erecting a new plant, consisting of generator house and boiler and engine house. The building is about 50 feet wide and 80 feet long. It will be fireproof throughout. The sidewalls are of brick, and the roof framing of steel, which will support the slate roof covering. The trusses are clear span—no interior columns—and rest directly on the side walls of brick. The steel work was furnished and erected in place by the Berlin Iron Bridge Company, of East Berlin, Conn.

GEN. GREELY, Chief of the U. S. Signal Service, states that out of 1,300 men, many of whom were engaged at the front, only five succumbed to disease. Two were killed and two officers had their horses shot under them.

THE NEW YORK TRADE SCHOOL has recently placed in operation two 70 h. p. engines of the Ball Engine Company, Erie, Pa., manufacture, each direct connected to Siemens-Halske generators.

FIFTY MILES can be traveled for one nickel on the Metropolitan street car system, if the New York "Press" is to be believed, and it presents a map to prove its assertion. At five miles an hour, ten hours would be consumed in such a trip.

SOUTHAMPTON, N. Y. Mr. Harris M. Howell, president of the Southampton Electric Light Co., writes us that there is a probability of putting in three miles of underground primary circuits in the near future. The plant comprises Wood alternators of 3,000 light capacity, 16,800 alternations, 1,000 volts primary, 110 secondary, and three miles straightaway transmission.

NIAGARA ELECTRO-CHEMICAL CO., whose works are located on the lands of the Niagara Falls Power Company at Niagara Falls, have decided to enlarge their sodium peroxide department by building an addition 50 by 125 feet. This building will be of brick, with iron girders and Macwirth roof. It is intended to make it thoroughly fireproof. At present it is not the company's intention to take any more power, but in the near future they expect to apply to the Power Company for additional electric force. The contracts for the work have been let and work will go ahead at once, the hope being to occupy the new addition early in February.

DIRECT U. S. CABLE CO. have, as usual, issued a very neat and useful block calendar to their friends.

WESTERN NOTES

SHEFFIELD, ILL. The Sheffield Electric Light Co., Sheffield, Ill., are installing an electric light plant—the Ball Engine Co., Erie, Pa., furnishing the engines.

CHICAGO'S INVESTIGATION of bribery charges against aldermen in the matter of street railway franchise extension has resulted in an entire dismissal of the case by the Grand Jury. The matter may now be taken up on its merits.

THE WESTERN ELECTRIC CO., of Chicago, will send, upon application, copy of Bulletin No. 100 describing fusible cut-outs for transformers, lines and switchboards. These cut-outs are of the S. K. C. types, and are of the most modern design and construction. They are adapted for any voltage between 1,200 and 6,000 volts. The cut-outs of the switchboards are of the multiple type, and if one fuse blows out another can be immediately switched into the circuit. The fuses for transformers and lines are mounted on weatherproof boxes, and all details have been carefully worked out.

THE CENTRAL ELECTRIC COMPANY, Chicago, report largely increased sales in the line of transformers, enclosed arc lamps, high grade knife switches and switchboards. They enjoy unexcelled facilities in the manufacture of the latter, and have recently furnished some very large and elaborate boards. Their new catalogue, just published, listing a line of special tablet and cut-out boards not shown in any other publication.

CHICAGO, ILL. The Municipal Police Signal Co. has been formed by J. Mackin, N. B. Cregier and H. Shafer, with a capital stock of $25,000, to manufacture electrical signals.

THE AUTOMOBILE CONTRACT beteween the American Electric Vehicle Co. and the Indiana Bicycle Co. has, we are informed, been abrogated.

VEEDERSBURG, IND., is erecting an electric plant. The Ball Engine Co., Erie, Pa., will furnish the engine.

THE BILLINGS WATER POWER CO., Billings, Mont., have recently placed in operation a 150 h. p. tandem compound engine of the Ball Engine Company, Erie, Pa., manufacture.

SAN FRANCISCO, CAL. The California Powder Works, San Francisco, have purchased a 100 h. p. tandem compound engine, built by the Ball Engine Co., Erie, Pa., for electrical purposes.

THE HUCKLEBERRY ROAD, as the Union Railway of New York is called, having had its charter sustained by the State Supreme Court, will proceed without delay with the development of its system throughout the Bronx district.

GRAND TRUNK TELEGRAPHERS are submitting their grievances to arbitration.

DENVER, COLO. Mr. Duncan Bond, Denver agent for the Ball Engine Co., Erie, Pa., has closed contract with the Moun-

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tain Electric Co., in Denver, covering required engines for electrical plant of the new Arapahoe County Poor Farm buildings. The Mountain Electric Co., acting as district managers for the Westinghouse Electric & Manufacturing Co., contract with the County Commissioners to furnish necessary electrical and steam equipment. The units will be direct connected and of the latest types of the respective makers.

THE WESTERN ELECTRICAL SUPPLY CO. of St. Louis, Mo., report very flattering sales this season on switches, of which they carry a very large and well assorted stock at all times. They are able to ship on receipt of order, any standard switch on the market. The Western Electrical Supply Co. also inform us that the Paranite and Peerless rubber covered wires for which they are agents, and constantly carry a large stock in St. Louis have never before in their existence received the patronage enjoyed this season, which they consider a very high compliment as to the merits of the wire. They also report good sales on their general line of supplies and a constantly increasing trade on general electrical supplies of very description, and electrical apparatus in which they are heavy dealers.

DIES AND STAMPING. Geo. M. Mayer Model and Machine Works, 79 Fifth avenue, Chicago, have during the past few years made a great many dies for switch levers, jack springs, connectors, shutters, etc., and are now doing a large business in that line. They will be glad to hear from manufacturers on the subject, and as to labor-saving machinery which may be needed for special purposes.

KANSAS CITY. The Missouri and Kansas Telephone Company celebrated on November 15 the establishment of the long distance Bell lines to St. Louis and Eastern cities, under the auspices of the Kansas City Commercial Club. There was a reception with lots of "tall' and "long" talking and music.

SOUTHERN NOTES

NEW ORLEANS, LA. People's Telephone Co. has elected as president, Mr. W. L. Holmes, who is also president of the Detroit Telephone Co. Mr. W. P. Curtis is manager.

SOUTH CAROLINA. A commission for a charter has been issued to the New England Electrical Company, of Cheraw, the capital stock to be $250,000. The object is stated to be to engage in a general manufacturing business. The incorporators are W. E. Price, E. A. Palmer, G. T. Nicholls, of Providence, R. I., and W. P. Pollock, of Cheraw.

LOUISVILLE, KY. The Electric Indicator Co. of Louisville has been formed by C. S. Dodson, D. T. Venderink, J. D. Keene and others, with a capital stock of $30,000, to make and sell the Keene & Roberts electrical indicator.

PHILADELPHIA NOTES

WILKESBARRE, PA. Manager S. E. Wayland, of the independent telephone company, has secured 1,073 subscribers, and expects to have the plant in operation by early summer. The lines are to reach Pittston, Ashley, Nanticoke, Plymouth, Kingston, Luzerne, Hazleton and other places in the county.

PITTSBURG, PA., had 822 fires last year, and only twelve were attributed to electricity, or about 1½ per cent.

PITTSBURG, PA. The Westinghouse Elec. & Mfg. Co. has just let contracts for large extensions of its shops at East Pittsburg, necessitated by the amount of new business on hand.

GEO. C. TOWLE MFG. CO. It is with pleasure that we note the splendid success of the Geo. C. Towle Mfg. Co., of Lancaster, Pa., whose advertisement appears in this issue. They have just moved into new quarters, the old being too small for their rapidly increasing business. The new factory is a very substantial two-story brick building, 150 feet long by 75 feet wide, with railroad siding. They expect this year to more than double their business over last year, and from present indications they will do it easily. They have already enough orders on their books to keep the shop running for three months. They are now manufacturing the fan motors for the new United States Mint Building at Philadelphia. Their 1899 catalogue is very tastily got up, and their models show great mechanical and electrical ingenuity. Their new ceiling fan is going to be a great success.

ST. AGNES' HOSPITAL, Philadelphia, has its electric plant in operation. Two engines built by the Ball Engine Company, Erie, Pa., direct connected to Eddy dynamos furnish the power.

PENN ELEC. MFG. CO. will, it is said, move its plant from Pittsburg to Irwin, Pa., where it is to get a bonus of $5,000 and a site. The firm employs 60 men.

THE PENNSYLVANIA ELECTRIC CO., of Marietta, Pa., is the recipient of a medal for the highest grade of telephonic apparatus, from the Omaha Exposition, it being the highest award in that class. The medal is accompanied by a handsome diploma of merit. The management of the company are highly pleased at this result in view of their recent advent into the field as compared with many other concerns. The company is also receiving daily other awards of merit in the shape of fine contracts, and is busy filling an order for 2,000 telephones from the Independent Telephone Co., of Lancaster, Pa.

NEW ENGLAND NOTES

BOSTON SUBWAY EXPLOSION. A verdict has been found against the Boston Gas Light Co., in the celebrated subway explosion case. The suit against the Boston Electric Light Co. and the Edison Co. was discontinued. Damages aggregating $1,000,000 are claimed.

AMERICAN ELECTRICAL WORKS, Providence, R. I., have issued a handsome, large calendar, with the lettering steel engraved bearing a fine portrait of Morse. It is an appropriate ornament for electrical offices.

THE ROLAND F. OAKES CO., Rutland, Mass., have purchased two 40 h. p. engines for electrical purposes from the Ball Engine Co., Erie, Pa.

THE WRIGHT DEMAND METER will continue to be handled in the New England territory by Messrs. R. S. Hale and J. S. Codman, who have recently formed a partnership in Boston.

BERLIN IRON BRIDGE CO., of East Berlin, Conn., have recently built for the town of Newport, Herkimer County, N. Y., a bridge having two spans of about 70 feet each. This bridge is of the parabolic type, with steel floor beams and stringers.

LOMBARD WATER WHEEL GOVERNOR CO. report that the demand for their governors is constantly increasing. During last month they received orders for upwards of twenty governors to regulate forty-one water wheels, which will develop 15,750 h. p. More than half of this machinery will be used in electric stations—principally in power transmission plants —and electric railway stations, the remainder being in textile and other manufacturing plants driven by water power.

MR. GEO. W. DAVENPORT notifies the electrical community that the Trustees Street Railway & Illuminating Properties have removed to Room 933, Exchange Building, 53 State street, Boston.

CROCKER ELECTRIC CO., 106 Fairfield avenue, Bridgeport, Conn., desire their friends to note this new address and write them or call upon them there.

FOREIGN NOTES

FRANCE has three submarine boats under preparation and test, two of which are already well known—the Gustave Zede and the Gymnote.

THE ELECT.-GESELLSCHAFT FELIX SINGER & CO., of Berlin, has lately received an order from the Oberschlesiche Dampfstrassenbahn-Gesellschaft for twenty electric street car outfits(Walker system), consisting of eighty motors, for a track gauge of 785 mm., which will be used on the new electrically converted lines of that company. It will be remembered that the above railroad company had previously ordered 208 motors and equipments from the same company.

M. DUCRETET is reported to have working at Paris, from his laboratory, a wireless telegraph line 2½ miles in length, the sending station being a mast 65 feet high above the laboratory.

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ADVERTISERS' HINTS

THE GENERAL ELECTRIC CO. advertise Brush arc generators, of the multicircuit type, in large varieties of sizes. They also give a list of some very heavy recent sales.

THE WARD LEONARD ELECTRIC CO., Bronxville, N. Y., state that within the last few years they have filled over 20,000 orders for rheostats.

C. F. SPLITDORF, 23 Vandewater street, New York, advertises his well-known coils, magnets and arc lamp spools.

BELLS AND PUSHES at reasonable prices are offered by Huebel & Manger, 286 Graham street, Brooklyn, N. Y.

THE EDDY ELECTRIC MFG. CO., Windsor, Conn., have something to say about their generators for heavy central station work.

WM. ROCHE, 259 Greenwich street, New York, are furnishing the "New Standard" dry battery in many sizes.

THE FORT WAYNE ELECTRIC CORP., Fort Wayne, Ind., advertise complete station equipments. They say their wattmeters will register accurately one 8 c. p. lamp.

THE LINK-BELT ENGINEERING CO., Nicetown, Philadelphia, offer to send two books describing their elevating and conveying machinery.

THE E. W. BLISS CO., Brooklyn, N. Y., describe and illustrate the new "Bliss" automatic press for notching armature core discs. Full particulars will be sent on request.

THE ROBBINS & MYERS CO., Springfield, Ohio, mention the special features of their "Standard" electric ceiling fans for all direct circuits.

MULTIPOLAR DYNAMOS AND MOTORS of the highest attainable efficiency, are offered by the Holtzer-Cabot Electric Co., Boston (Brookline), Mass. Compactness and symmetrical design are two of their many desirable features.

SAMSON CORDAGE WORKS, Boston, Mass., are advertising arc lamps and trolley cord. Their Samson spot cord, waterproofed, has long been considered standard for both purposes. They will send samples and full particulars on request.

THE RUSSELL-TOMLINSON ELECTRIC CO., 41 Cortlandt street, New York, offer two telephones for $5.00. They say that this is the first time that two perfect working, high grade instruments were ever sold at this price.

JEWELL STANDARD METERS, manufactured by the McIntosh Battery and Optical Co., 521 Wabash avenue, Chicago, Ill., are good instruments at very low prices. Their catalogue for 1898 is now ready and describes these instruments in detail, with prices, etc.

THE CUTTER ELECTRIC CO., 1112 Sansom street, Philadelphia, have some interesting comments to make on circuit breakers in general and the "I-T-E" circuit breakers in particular.

THE PARTZ ACID GRAVITY BATTERY for all open circuit work, is advertised by the S. S. White Dental Mfg. Co., Philadelphia. They claim it to be the highest voltage, strongest and longest lasting battery in the world.

THE WHEELER REFLECTOR CO., Boston, Mass., remind their friends of the results obtained by the use of their reflectors. With the same amount of light, properly distributed, an altogether different effect is apparent.

J. L. ROBERTSON & SONS, 223 Fulton street, New York, advertise several steam specialties. The Eureka packing is one of their specialties, and they say it will last three or four times longer than other brands and keep the rods in splendid condition.

RESISTANCE WIRE is advertised by Wilbur B. Driver & Co., 126 Liberty street, New York. Their "Climax" is said to have 48 times the resistance of copper, and their "Constantan" 30 times its resistance.

RUDOLPH GIESE, 162 West 27th street, New York, imports superior quality, patented dynamo brushes manufactured of chemically pure copper wire. He manufactures cast steel spring wire.

THE GEORGE C. TOWLE MFG. CO., Lancaster, Pa., are manufacturing power and fan motors in numerous styles for direct current. They illustrate their "ad" with several cuts of them.

THE STANDARD THERMOMETER & ELECTRIC CO., Peabody, Mass., advertise their new No. 300 enclosed arc lamp for indoor and outdoor service. They guarantee a life of 120 hours with one set of carbons.

THE W. F. & JOHN BARNES CO., Rockford, Ill., offer their No. 5 foot-power, screw-cutting lathe at $90. The lathe is illustrated in their "ad" in this issue.

THE C. W. HUNT CO., West New Brighton, Staten Island, N. Y., devote their space to a brief description of the Hunt electric conveyor device, and the Hunt noiseless gravity conveyor. The former is shown in a half-tone.

THE PHOENIX GLASS CO., 15 Muray street, New York, manufacture electric light globes and shades, arc and incandescent, for all systems; gas globes for Welsbach and other gas burners, and decorated lamps and globes.

THE C & C ELECTRIC CO., 143 Liberty street, New York, call attention to a generating set installed by them for the H. B. Claflin Co., New York, including a 100 k. w. 8-pole C & C "M. P." generator. A cut of it is shown.

THE STROMBERG-CARLSON TELEPHONE MFG. CO., 70-82 W. Jackson Bvd., Chicago, Ill., advertise "a new thing" in telephones—a central energy telephone system. It is illustrated and its salient features touched up in their "ad" this week.

THE WESTINGHOUSE ELEC. & MFG. CO., Pittsburg, Pa., recommend their enclosed arc lamps for house and store lighting. They are made for either direct or alternating current.

GAS ENGINES form the topic of the Westinghouse Machine Co.'s "ad." They are now building them for railway service in all sizes up to 750 h. p. In efficiency they claim they cannot be surpassed, producing a horse power on less than 12 cubic feet of natural gas.

THE NEW YORK & OHIO CO., Warren, Ohio, have just distributed their new catalogue, and request that any one who has been overlooked will send in their name.

THE GENERAL ELECTRIC CO. call attention to the G. E. Type "H" transformer, as by its use, they state, many central stations now operating at a loss may be made paying investments.

McLEOD, WARD & CO., 27 Thames street, New York, advertise the Kinsman desk lamp and the Ward orchestra lamp, both of which they claim to be the best of its kind.

WM. T. PRINGLE, 1026 Filbert street, Philadelphia, calls attention to the "New Style" receptacle and attachment plug manufactured exclusively by him and for sale by all dealers in electrical supplies.

THE GARVIN MACHINE CO., Spring and Varick streets, New York, advertise machine tools for all metal work. They illustrate their No. 2 automatic tapper. Their new catalogue is just ready for distribution.

THE WHITNEY ELECTRICAL INSTRUMENT CO., of Penacook, N. H., and Sherbrooke, Quebec, offer a large assortment of switchboard and portable instruments for direct and alternating currents.

ZIMDARS & HUNT, 127 Fifth avenue, New York, suggest their switches, switchboards and panel boards as good things for the new year, but they might add that they are good things for the whole year.

THE ELECTRIC APPLIANCE CO., 242 Madison street, Chicago, recommend the two-ball cord adjuster as the simplest and best device of its kind on the market. Circulars and trade prices may be obtained on request.

THE AMERICAN INDUSTRIAL PUBLISHING CO., Bridgeport, Conn., advertise two new books. One is on the destruction of steam boilers and the other on refrigeration and ice making machinery.

THE BALL ENGINE CO., Erie, Pa., call attention to the very high quality of workmanship and material in their engines. The sun never sets on Ball engines.

THE INDIANA RUBBER & INSULATED WIRE CO., Jonesboro, Ind., reproduce the medal and diploma received by them from the Trans-Mississippi Exposition, 1898, for "Paranite" rubber covered wires and cables. They manufacture them to suit all classes of service.

THE WAITE & BARTLETT MFG. CO., 108 East 23d street, New York, carry a replete stock of electro-medical and electro-surgical instruments. The Ranney-Wimshurst-Holtz static machine supplied by them is in use for X-ray examinations in many of the leading New York hospitals.

J. JONES & SON, 62 Cortlandt street, New York, take this opportunity to wish their many friends a happy and prosperous New Year, and refer to their large stock of electrical supplies.

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THE VICTOR ELECTRIC CO., 418 Dearborn street, Chicago, manufacture a full line of high grade electrical dental and surgical specialties, including induction coils, switches, rheostats, dental engines, cataphoric obtunders, shunt boxes, electric lathes, etc. Some of their apparatus is illustrated.

THE IRON CLAD RESISTANCE CO., Westfield, N. J., will be pleased to mail their 1899 catalogue descriptive of their rheostats and theatre dimmers. They say it is clear, concise and complete.

THE CHRISTIANA MACHINE CO., Christiana, Pa., are prepared to erect complete water power plants. They also manufacture every appliance for transmitting power, such as gearing, shafting, pulleys, friction clutches, etc. They say to send for their illustrated water wheel book.

CLUSTER REFLECTORS, with three to ten lights, lined with silver plated corrugated plate glass, for stores, banks, waiting rooms, etc., are advertised by I. P. Frink, 551 Pearl street, New York.

THE NEW YORK TELEPHONE CO. cite the experience of a business man who, for the sake of economy, denied himself telephone connection, but who would not now do without it for $500 per year.

BERG & CO., 176 Broadway, New York, are contractors for electric equipment and installation. They do wiring for all systems.

DYER, EDMONDS & DYER, 31 Nassau street, New York, mention the fact that they have done all the patent soliciting work for Mr. Edison.

THE S. MORGAN SMITH CO., York, Pa., will furnish estimates for complete water power plants and guarantee results. The McCormick turbines have made a record for themselves.

THE LEATHER PRESERVER MFG. CO., 27 W. Monroe street, Chicago, Ill., wish to purchase old belts, or scraps, no matter their size or condition.

THE WAGNER ELECTRIC MFG. CO., St. Louis, Mo., announce to their friends and patrons an extension of their manufacturing facilities such as will enable them to more promptly meet the calls upon them.

ARC LIGHTING DYNAMOS are advertised by the Western Electric Co., in sizes from 50 light to 150 light, 9.6 amperes and from 85 light to 180 light, 6 amperes.

THE CROUSE-HINDS ELECTRIC CO., Syracuse, N. Y., advertise switches, switchboards, panelboards and special work of all kinds. Several styles of their apparatus are shown in their space this issue.

THE ELECTRICAL TRADING CO., 326 Dearborn st., Chicago, Ill., offer some bargains in transformers, incandescent lamps and all kinds of supplies.

QUEEN & CO., Philadelphia, Pa., advertise meters and testing instruments of their celebrated make, many of which were described in a recent issue of The Electrical Engineer.

A MONKEY HOUSE was equipped with electric heaters as they were found safer than anything else that could be put within the monkey's reach. The heaters were made by the American Electric Heating Corporation, of Cambridgeport, Mass.

CHAS. J. BOGUE, 213 Centre st., New York, offers automatic focusing lamps for direct or alternating circuits, single or in series and of any candle power. He also supplies searchlights and projectors in all sizes.

THE DEARBORN DRUG & CHEMICAL CO., La Salle st., Chicago, present some illustrations of boiler incrustation. They offer to analyze free of charge samples of boiler water and to tell the interested parties what can be done to obviate the difficulties.

THE CAMPBELL ELECTRIC TRACTION CO., 451 Greenwich st., New York, set forth the points of merit of their surface contact closed conduit system. It is described more fully on another page of this issue.

THE ERICSSON TELEPHONE CO., 20 Warren st., New York, say their instruments build up a service by doing good work and the profits by keeping the cost for maintenance and repairs at the minimum.

PORTABLE ELECTRIC HEATERS form the subject of the American Electric Heater Co.'s ad. They are designed for heating bath rooms, small offices, etc. The company's address is 197 River st., Detroit.

HART & HEGEMAN MFG. CO., Hartford, Conn., illustrate several styles of their celebrated switchs and call attention to their characteristic features.

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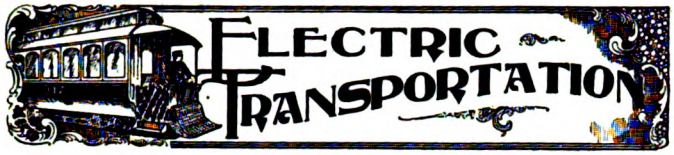
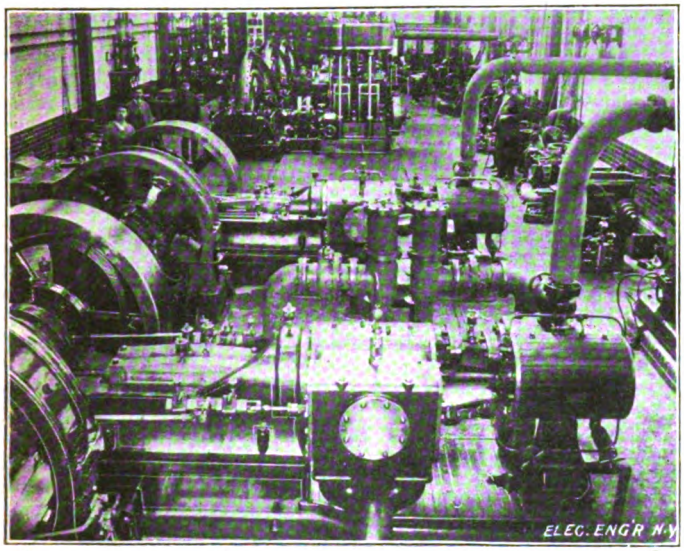


An American Trolley System at Dover, England.

ONE of the cities of England boasting both electric lighting and electric railway plants is the old Cinque port of Dover, the chief gateway of communication between England and France. To anyone who has traveled across the turbulent Channel between Dover and Calais, in the old days of the gas lamps, the change in the lighting system of the port is a welcome surprise; and this surprise is not lessened at the view of the trolley cars which travel along the narrow streets of the town where formerly passenger traffic was carried on by a very inadequate system of horse omnibusses.

Both lighting and railway plants are the property of the Dover Electric Supply Co., and are housed in the same building; the lighting plant being distinctly English, the power plant just as distinctly American. The station on Park street, about 100 feet from the river, is the usual substantially built English station,



RAILWAY POWER END OF STATION, DOVER, ENGLAND.

covering an area of 10,000 square feet, with a height of 30 feet to the eaves. The engine and dynamo room is 100 feet long by 30 feet wide, the boiler room 100 feet long by 42 feet wide. The boilers are all of the Babcock & Wilcox type, the two rear ones being connected in with the two first installed. The steam pressure used is 150 pounds. The lighting plant consists of four Mordey Victoria alternators, having a total capacity of 325 k. w., directly driven by vertical compound engines built by the Brush Electrical Engineering Co. The lighting plant was inaugurated early in May, 1895, since which time the electric light has come steadily into more widespread use, although it has had to meet vigorous competition from the cheap gas.

The railroad has been running a little over a year and has been uniformly successful. The road is owned by the municipality which, accepting the report of its consulting engineer, Mr. Stephen Sellon, decided not to build its own station, but to purchase the railway current from the Dover Electricity Supply Co., which agreed to erect the railway generating plant necessary for this purpose.

The two engines driving the railway generators are horizontal tandem compound McIntosh & Seymour machines, each 11 inches by 9 inches by 15 inches stroke, running at 235 revolutions per minute. Each is directly connected to a six-pole compound wound British Thomson-Houston railway generator of the ribbed frame type, having a capacity of 100 k. w. at 500 volts. For use at night time when very few cars only are running, a motor generator has been added. This takes alternating current at from 2,000 to 2,200 volts from the main alternators, and delivers direct railway current at 500 volts or vice versa. During the daytime it is driven from the power generators and supplies

LIGHTING END OF STATION, DOVER, ENGLAND.

the small amount of current necessary for lighting purposes. During the nighttime it is driven by the alternators and furnishes the small power required to run the night cars.

The switchboard is built up of three B-T-H panels, two for the generator and one for the main circuit. They are equipped with standard railway devices and with ammeter and voltmeter of Weston make. The board also carries a recording ammeter and recording voltmeter as well, and each circuit is protected by an automatic circuit breaker and lightning arrester. A black enameled slate panel has been placed in the office of the Borough Engineer, Mr. Stilgoe, at the Town Hall, to enable him to learn the condition of the station at any time. The panel is equipped with a 600 volt voltmeter, a 300 ampere ammeter, and the necessary switches to cut them into the circuit.

All the power from the station passes through the wattmeters, the one checking the other. In case the two readings show a variation of more than five per cent., a third meter is employed, and the reading on this forms the basis of current charge from the Electricity Supply Co. against the city. At the corner of Worthington and Biggin streets, is a special switch pillar, in which is set a distribution switchboard. It is from this point that

SIDE POLE CONSTRUCTION, DOVER, ENGLAND.

complete control of the entire system is had. The pillar is divided into two compartments, the upper containing the contacts controlling the different sections, the lower the Board of Trade test wires and the lightning arresters. There are no feeders.

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The suspension is of the single bracket type, with the exception of that on Market place and King and Biggin streets, where the track is double. The single brackets carry the two trolley wires, one for cars going in one direction and the other for cars going in the opposite direction. This avoids the necessity for overhead turnouts and switches. The poles are ornamental and some carry arc lamps. The trolley wire is No. 0 B. & S. hard drawn copper. The overhead system is divided into sections each about half a mile long, connected each to the other by knife switches concealed in iron pillar boxes. A pilot wire is carried the whole length of the line and is connected to each switch pillar. A telephone circuit is also connected from the different points to the Borough Engineer's office and to the generating station.

The main line runs from the terminal stations of the South Eastern and London, Chatham & Dover Railways on the Admiralty Pier as far as Buckland, a suburb lying north of the town. The steepest gradient on the line is 1 inch in 13.5. The sharpest curve one of 44 feet radius. At Worthington street a branch line runs out to Maxton. The total length of both main and branch lines is 3.5 miles.

The track is laid in 6 inch girder rails, 85 pounds to the yard, on a continuous block of cement concrete to a gauge of 3 feet

CENTRE POLE CONSTRUCTION, DOVER, ENGLAND.

6 inches. Between the blocks a bed of concrete is laid in and the granite paving blocks are laid on a sand bed on the concrete. The road is single track with the exception of the short length mentioned.

The rolling stock consists of eight motor cars and two trailers, 6 feet 4 inches wide and 25 feet long over all; they accommodate 44 passengers, 20 inside and 24 on the upper deck, which is provided with garden seats. The car bodies were built by the Brush Electrical Engineering Co. and the trucks by the Peckham Truck Co.

Each motor is equipped with two British Thomson-Houston 25 h. p. motors, controlled by K2 series parallel controllers. The trolley pole, of the swivel pole and base type, is set at the top of a small pillar at one corner of the upper deck, out of the way of the passengers. Each car carries a recording wattmeter, measuring the energy consumption of the car. The performance of the motorman and the motors is thus checked daily.

The road was constructed by Dick, Kerr & Co., who also supplied the rails. The electrical equipment of the power plant and cars was furnished by the British Thomson-Houston Co., of London.

Electric Light for Russian Coaches.

An edict has been issued, it is said, that all Russian railway carriages must be lighted by electricity by means of accumulators. First-class compartments will be lighted by 100-candle power; second-class by 80-candle power, and third-class by 50-candle power. In every compartment stearine candles must be also supplied in case the electric light is not available.

Big Trolley Deal in New Jersey.

On January 5, the North Hudson County Railway Company passed formally into the control of the North Jersey Street Railway Company. The plan is to operate the North Hudson system as a separate road under North Jersey management. David Young, now vice-president of the North Jersey, will be president of the North Hudson Company. The North Hudson Company, under its new management, will almost double its trackage within a short time. The control of the Palisades Electric Company, at Fort Lee, has passed into the North Jersey's hands. The line of the New Jersey Electric Company, from Hoboken to Little Falls, is also expected to be in the hands of North Jersey Company men within a few months, as it is in the hands of a receiver and has been for sale for some time. Other small lines in Bergen County are also expected to pass under the same general control.

When the details have been arranged and the small lines secured it is proposed to operate the roads in three systems. The lines in Jersey City, Passaic, Paterson, Orange, and the intervening towns will be operated as the North Jersey Street Railroad Division proper. The second division will be the North Hudson one, and will comprise the lines just secured, with the Bergen County roads which are expected to be acquired. The third division will be the Orange and Passaic Valley. At the present time this is but a very small division, but the plans are to continue the line northward into Passaic County, from Bloomfield southward into Union, where the same management has lines, and westward into Morris County, into Morristown, and eventually into Dover.

Havana, Cuba, Electric Street Railways.

The Havana Electric Railway Co. has been incorporated in New Jersey, with $5,000,000 capital, to work the Havana Street Railway and railway grants purchased by the G. B. M. Harvey Syndicate of New York City. Mr. Harvey has started for Havana to look over the properties and options purchased on the island by the agents of the syndicate. The syndicate already controls all the street railways and railway franchises of Havana. The Ferro Carril Urbano system was purchased on Dec. 29. This system has 27 miles now in operation and will be extended at once to about 50 miles. It is principally operated by mule power, but the branches to Guanabacoa and Vedado are run by steam. There is another suburban branch to Jesus del Monte. The Guanabacoa line, crossing by ferry from Havana to Regla, and thence by steam, has a good freight business, but the other lines are confined to passenger traffic.

President Alvarez, Secretary Pendas and Attorney Cerra, on the evening of Dec. 29 met the agents of the syndicate, F. S. Pearson, Percival Farquhar, Theodore de Zaldo, with Senor Gelato, a Havana banker, acting as financial agent of the syndicate, and gave a certified check for $1,472,000, representing 92 per cent. of the par value of the stock, amounting to $1,600,000. The stock, it is said, could probably be sold at 150 or more.

The lines began operations under the syndicate on Jan. 1, and will be continued under that management until the company now incorporated takes hold. Electric equipment will be installed at once throughout the whole system. The J. G. Brill Co. will supply the cars and the Westinghouse Co. the electrical machinery, though contracts have not yet been placed.

The Harvey syndicate is said also to have bought the electric light plant at Santiago. The extension of the Havana railway system, which will be begun at once, will be partly on the lines of the Urbano franchises, but principally on the Torres grant. When the extensions now contemplated are finished the company will have some 50 miles of road. F. S. Pearson, chief engineer of the Metropolitan Street Railway Co., is in Havana to reorganize the system and to inaugurate the trolleys.

The Harvey syndicate is looking over the Cuban business field generally, and has taken options or investigated all kinds of companies, from railways and electric lighting plants to mines and plantations. Others interested, besides Messrs. Harvey, Pearson and Farquhar, are Harry Payne Whitney, W. K. Ryan, son of Thomas F. Ryan, the street railway capitalist; Senator James Smith of New Jersey, Hanson Brothers of Montreal, J. W. Todd and Ernest Ruffe of London, Theodore de Zaldo, the Havana banker, and the Banque Internacionale of Paris. The syndicate works under a temporary New Jersey charter, as the Cuban Electric Co., with $1,000,000 capital.

SEATTLE, WASH. The Union Electric Co. has prepared plans for a new central station to cost $250,000.

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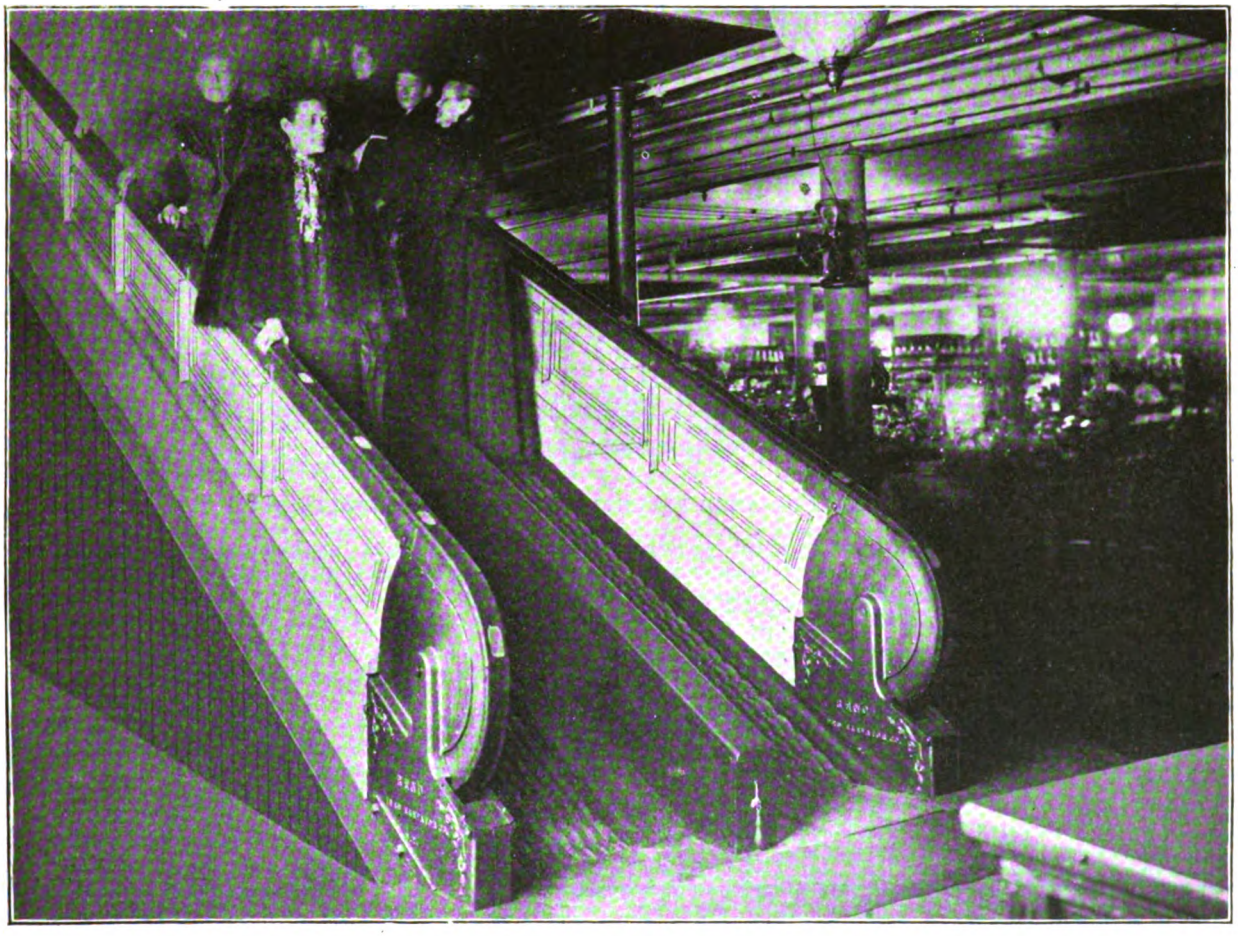
The Reno Duplex Inclined Elevator.

APPARENTLY keeping up with modern advances, stairways are becoming automobile to so large an extent that their manufacture and development has ripened into quite a good-sized and practically profitable industry. That class of public conveyances has been very successfully covered in this country by Mr. J. W. Reno, whose inclined elevator or moving stairway which was installed in the department store of Bloomingdale Bros., New York, was fully described and illustrated in our issue of July 7, 1898. The details of the apparatus, every piece of mechanism and the power consumed, were noted at that time and the many advantages possessed by the system were pointed out. After a continuous operation of eight months, this elevator shows hardly any wear, and due to this fact and its very successful and profitable working, it has attracted a great deal of attention and has induced Mr. Reno to develop his scheme by duplexing the elevator, providing a continuous up and down conveyance for passengers. One of these duplex elevators, shown in the illustration, has been installed in the store of Frederick Loeser & Co., Fulton street, Brooklyn. It carries passengers up and down between the first floor and the basement at the rate of 6,000 patrons per hour, doing the work of the seven vertical elevators, which, since its introduction, have ceased running between these floors.

During the holiday season, this elevator, which has become exceedingly popular, carried as high as 25,000 passengers in one day at a cost for power of one dollar per day, and has relieved the vertical elevators of the crowding which they previously experienced. The cost of power, as quoted, seems almost incredible.

The up and down inclines are geared together so as to work in opposite directions, a 5 h. p. C & C iron-clad motor located under the machine furnishing the power. The elevator, when running without a load, takes 5 amperes, and when loaded equally on up and down sides, 8 amperes at 110 volts.

The company now have four machines in operation on which over 1,000,000 passengers have been transported. They are also negotiating with the Paris Exposition authorities for the installation of twenty or more of the Reno elevators in the galleries of the 1900 Exposition buildings. The U. S. and foreign patents are controlled by the Reno Inclined Elevator Company, Room 10, Mills Building, New York. Attention was called in these columns recently to the extensive use proposed by the Exposition authorities for Paris in 1900.



RENO DUPLEX INCLINED ELEVATOR IN FREDERICK LOESER & CO.'S STORE, BROOKLYN, N. Y.

Land for New York Power Plants.

The purchase is announced, for $100,000, of a lot at the southeast corner of Ninety-seventh street and First avenue, from Peter F. Kane by the New York Gas & Electric Light, Heat & Power Co., which is better known as the W. G. Whitney syndicate. The property is very close to the new $10,000,000 electrical plant of the Metropolitan Traction Co., with which the public is already familiar.

Mr. John D. Crimmins has also, with kindred objects in view, it is said, bought Berrian's Island, on the Sound, adjacent to Long Island City.

New Plan to Utilize Niagara Falls.

The Miller Electric Construction Company of Pittsburg has invented a new plan to utilize the power of Niagara Falls, and it is expected work will begin the first of the year. The plan will necessitate the expenditure of about $500,000. It is proposed to erect a large building close to the falls, it being kept in place by anchors and heavy iron cables. With a series of contrivances it is expected to utilize all the force of the falling

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water. Electrical current is to be transported by conduits and heavy wire to distant points.

TELEPHONY AND TELEGRAPHY

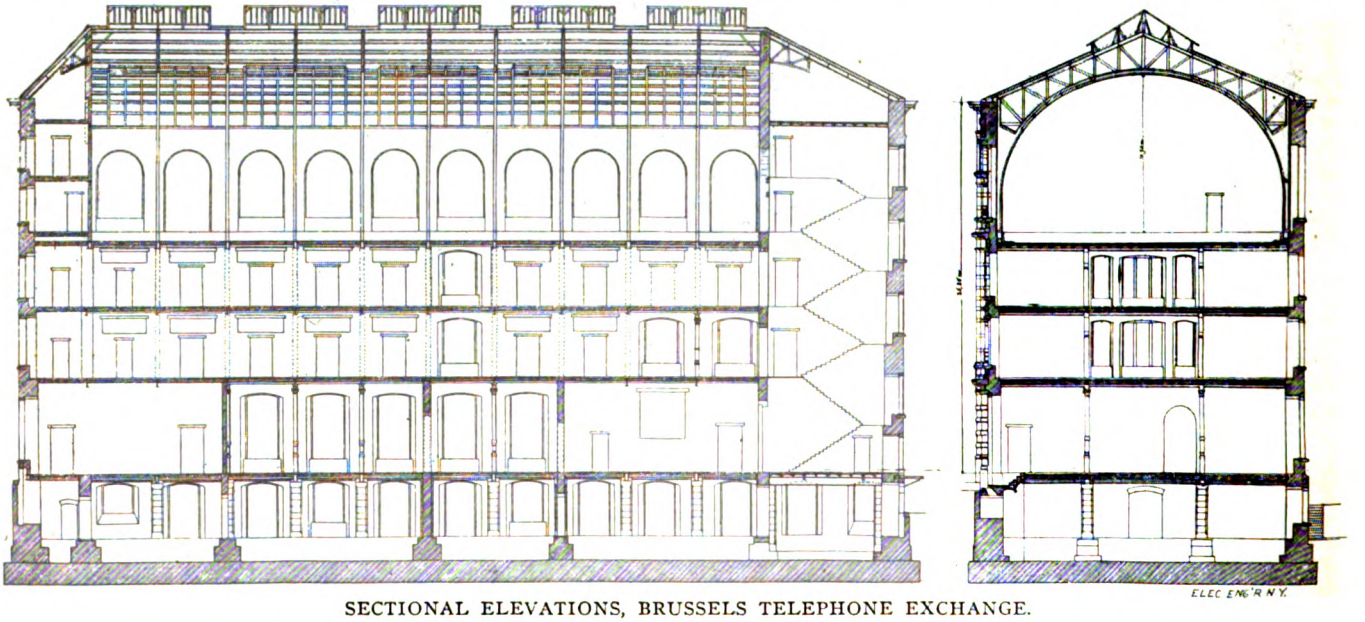
The New Telephone Exchange for Brussels, Belgium.

THROUGH the courtesy of Mr. G. W. Roosevelt, U. S. Consul at Brussels, Belgium, we are able to present this week the plans of the new telephone exchange which is shortly to be opened by the Government in Brussels this year, as noted recently in our columns. It will be one of the very largest exchange buildings in the world, and is to be devoted exclusively to telephony.

The building is situated in the old quarter of the city, the selection of the location being influenced by economical reasons, as the land was Government property. The construction of the building has cost very nearly $200,000, and there will be connections for 15,000 subscribers, there being about 3,000 at the present time. It comprises a basement, ground floor, and three stories. The room at the top of the building devoted to the switchboard has a length of 147 feet, a width of 65 feet, and a height of 30 feet. The various stories are reached by two stairways, one of generous proportions exclusively for the public, and the other of narrow dimensions devoted to the use of the personnel of the service. When the building is entirely completed and ready for public use, each subscriber will have connection with the central by metallic circuit. Part of the operating floor is devoted to the local service and part to extra-territorial or suburban work.

On account of the large number of overhead traction cables already existing in the city and the impossibility of a much further increase in the number or dimensions of telephone-support frames (chevalets), it has been decided to put nearly all the wires of the Brussels telephone service under ground, and in consequence cables containing two hundred wires each will be placed in underground conduits, to be distributed in the various quarters of the city. When necessity presents, one or more of these cables will be carried overhead, attached to a chevalet placed on a house top, and distributed to subscribers in that locality. It will be noted that the plans make provision for both overhead and underground connections to the exchange.

CENTRAL TELEPHONE EXCHANGE RECENTLY ERECTED AT BRUSSELS, BELGIUM.



SECTIONAL ELEVATIONS, BRUSSELS TELEPHONE EXCHANGE.

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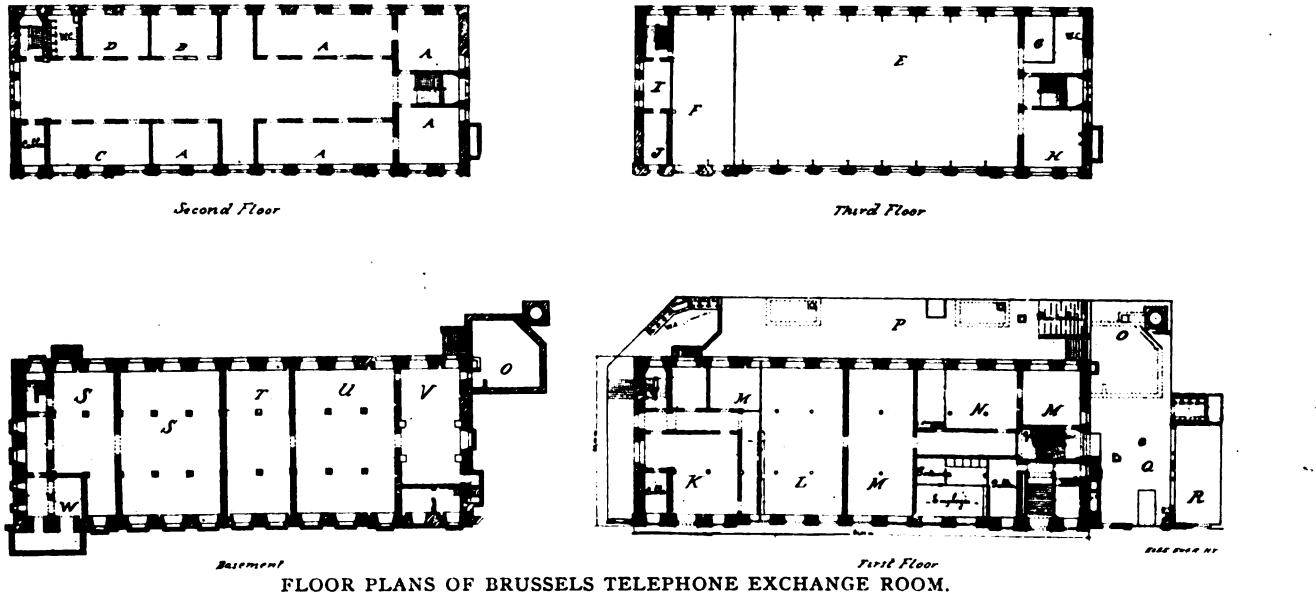
The building will be heated by the system patented by Mr. L. d'Anthonay. A gas machine of 3 horse power will operate a turbine which forces cold air in the heating apparatus and drives it into the various rooms when at a proper heat and moisture. This system permits the admission of air whenever desired. It reduces to a minimum the amount of humidity and dust resulting from heating and ventilation, two causes exercising the most harmful influence upon the working of apparatus for telephonic communication. Another advantage resulting from this system of heating is the power of cooling the air in the building during the summer.

Below the massive concrete foundation, a series of iron beams has been laid. Steel shanks are attached to these rafters and connected with the iron pieces of the building in all directions in



FLOOR PLANS OF BRUSSELS TELEPHONE EXCHANGE ROOM.

BASEMENT.—O—Coal Pocket. V—Boiler Room. T—Forge. U—Machinery Room. S—Material Room. W—Cable Vault (Entry). FIRST FLOOR.—Q—Upper Courtyard. P—Lower Courtyard. M—Apparatus Room. N—Workshop. L—Room for Line Material. K—Linemen's Quarters. SECOND FLOOR.—A—Offices. B—Conference Room. C—Laboratory. D—Battery Room. THIRD FLOOR.—I—Battery Closet. J—Aerial Wires (Exit). F—Suburban Service. E—Switchboard Room, Local Service. G—Superintendent. H—Refreshment Room.

such a manner that the entire construction is united in a Faraday cage, which thoroughly protects it against lightning. Every possible precaution has been taken to render the building fireproof. A large number of fire escapes will also be added. The building is located at the corner of the Rue de la Paille, and the plans herewith are those accompanying the official report of Mr. L. Van der Aa, the Government architect of the Postal and Telegraph Departments.

Special pains have been taken to secure good light for the operating room both by day and by night. It has windows both on the street and in the central court, and the central part has also five "lantern lights" as indicated on the plans. At night, illumination will be furnished by arc and incandescent lights. The conduits throughout the building, in the walls, provide for the lighting circuits. The cost given above does not include any estimate for a lighting plant.

Hawaiian Cable Grant.

Secretary of State Hay has formally disapproved the concession made in July by the Hawaiian Government to the Pacific Cable Company for an exclusive right of laying cable to Hawaii. It is understood that this action was taken in no spirit of hostility to the Pacific Cable Company. The concession was disapproved of on account of the formal protest made by theHawaiian Commission, and because it seemed best to leave to Congress a free hand in the disposition of the whole subject. The concession was granted by Hawaii on July 2, and there was a provision which covered the expected annexation, giving the United States a right to disapprove within six months, if, in the meantime, annexation had been accomplished. The Pacific Cable Company was a New York concern.

Mr. Corliss, of Michigan, has introduced a bill in the House of Representatives to secure the construction of a cable connecting the mainland of the United States with Hawaii, the Philippines, Japan and China.

It authorizes the President to cause the cable to be laid, and an appropriation of a sufficient sum to secure a cable that will carry at least fifteen words a minute. When the cable is completed it shall be turned over to the Post Office Department and operated as part of the postal service.

Gen. Greely, of the U. S. Signal Corps, estimates the cost of a cable from San Francisco to Luzon at about $10,000,000. The route will probably be from San Francisco to Wake Island, to Guam and to Manila. The route has never been surveyed further than Wake Island. The Spaniards declined to sell one of the Carolines, which extend 2,000 miles east and west. This would have been the best and cheapest route, but the Government will proceed by the route noted.

The intention of the Government to undertake the San Francisco-Manila cable is foreshadowed by its determination to connect the Philippine Islands by cable as speedily as possible.

A Government Cable Steamer for the Philippines.

Colonel Kimball, of the Quartermaster's Department in the Army Building, New York City, has received orders from the War Department to secure at once an iron ship of from 1,000 to 1,200 tons burden to lay cables to connect the islands of the Philippines.

The Department has already ordered for this purpose 166 miles of marine cable, weighing 525 tons. This cable will take about 6,500 cubic feet for coiling. The cable is to be coiled in skeleton tanks in different holds on the vessel.

The cable ship must accommodate on the forward deck the "giving-out" machinery, which will weigh from fifteen to twenty tons, and the accessories, weighing from five to ten tons. In the after hold will be fitted out the quarters for the crew of twenty men. This space will be used for coal on the way out. The ship will be kept on station as a cable ship, or can, if necessary, be used as a transport.

Government Telegraphy in France.

"The French are not in it as far as the telegraph is concerned," observed a Washington merchant who has just returned from a hurried trip abroad. "On my arrival at Havre three weeks ago I sent a telegram to Paris to my hotel engaging a room. At the same time I sent a cable to my family in Washington reporting my arrival. Three hours afterwards I arrived in Paris to find my answer from this country. But the telegram I sent from Havre did not reach Paris, or at least was not delivered there until after I had been at the hotel over an hour. In one case it was a matter of but a few miles and in the other a distance of several thousand. The telegraph wires worked as rapidly in one case as in the other, but in the service the delivery was where the trouble was. The

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French make no special effort at rapid delivery of messages, and indeed make no claim in that direction. They are accurate enough but very slow. Thinking I would save time in Paris by using the telegraph, I sent a number of messages to friends and business people in different parts of the city. In nearly every case the messages were delivered after I had had time enough to make my visits in person. My experience is like that of others, for we all found out that such a thing as rushing is unknown to the telegraph service there."

Bell Telephone in Michigan.

A special dispatch from Cleveland, O., of Jan. 4, says: One of the biggest telephone deals in the history of the business is about to take place. Papers were executed to-day to transfer a large interest in the stock of the Michigan Telephone Company and to place the management under the control of the managers of the Cleveland Telephone Company. The Michigan Company operates exclusively under the American Bell Telephone Company's license in Michigan with 19,000 subscribers and 10,000 miles of long distance wires. The capital stock of the company is $2,500,000. "The new arrangement places under the Cleveland Company the management of the largest number of subscribers in the United States," said Mr. J. P. McKingsley, general manager of the Cleveland Telephone Company. "There are in all 50,000 subscribers and 30,000 miles of toll line. The added development of this combined territory cannot be less than 15,000 subscribers in 1899, comprising the States of North Dakota, South Dakota, Minnesota, Michigan, Arkansas and Texas. It would not be surprising if the copper district in Northern Michigan were talking with Boston before the close of the year."

ELECTRIC LIGHTING

Thomson Two-Rate Recording Watt Meter.

WE have recently considered in our columns methods of providing central stations with continuous full load so that the machinery may always run at maximum efficiency, or in other words, the problem of supplying load at slack hours, attaining a uniform load, avoiding idle capacity, and securing a constant revenue from all the station apparatus.

To load a lighting station up to its maximum output is not difficult during early winter evenings. We are all conversant with the ordinary station curve (as shown in Fig. 3) which shows a low level line from midnight to daylight, a sudden and disproportionate drop in the early morning hours, a sudden leap to the maximum output by 5 p. m. and a steadily descending line to midnight. During 16 hours out of the 24, fixed charges continue constant, and operating expenses are only slightly decreased, but the revenue shows a curve coincident with that of the load. The fixed charges on the apparatus which carries the peak have to be earned in a few hours each day. It is an important problem and one to which central station managers and engineers have given much time and thought, all arriving at the conclusion that, reduced to its simplest expression, it is a mere question of supply and demand, in the discussion of which customers and station must conciliate their interests to mutual advantage. Thus, when the station is most heavily loaded, that is when the demand is great and the supply is restricted, then those participating in the supply should pay a more equitable share towards fixed charges in conformity with the fundamental principles of economic law. When the station is least loaded, that is when the demand is restricted and there is a superfluity of supply, greater liberality of charge is permissible.

Reduction in price is, without doubt, the only means which experience shows can be successfully employed to induce an increase in demand and a consequent employment of otherwise idle machinery in the station; but to effect this reduction in price, i. e., to give a consumer electricity at one price during the hours of maximum demand on the station and at a reduced price during the hours of medium or minimum demand, a means of recording the consumption during two distinct periods is necessary. Such a load modifying system, however, to be successful, must essentially be independent directly or indirectly of the consumer's local conditions and depend entirely on station conditions. The high rate of charge must be coincident with the maximum peak period of the station, the low rate upon the period of smallest demand, thus giving great encouragement to the use of current at periods other than that of the station peak. This is the object towards which central station managers are striving—to build up the daily load curve to as near the value of the maximum point as possible—not so much the flattening of the peak, but the steady elevation of the daily depression—as well as the creation of all possible local peaks not occurring at the period of station peak. Two instances of this may be cited. A newspaper office does the bulk of its work after midnight and before 3 a. m., giving a local peak at the very hours when the station peak has ordinarily subsided; users of motive power over brief periods during the day will also give what, compared to the average load line, are decided peaks. To encourage such consumers the low rate must be applied or the competition of other systems will necessarily prevail.

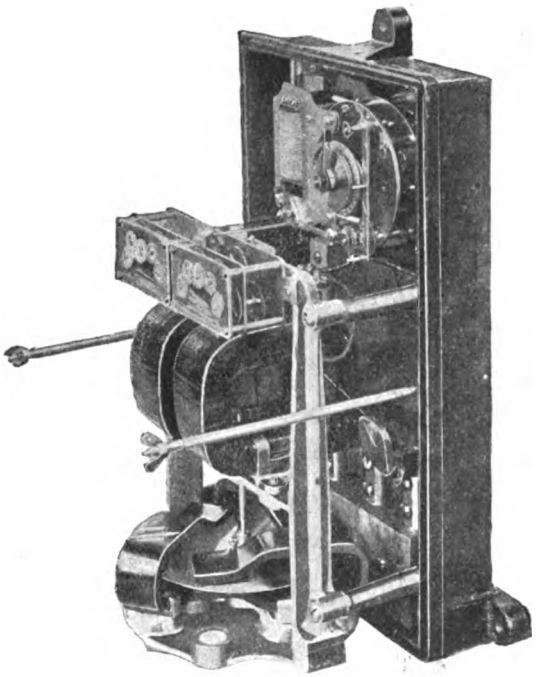

FIG. 1—THOMSON TWO-RATE RECORDING WATT METER—OPEN.

Careful consideration of this question of station load has brought about the development by the General Electric Company of a two-rate recording wattmeter, a combination of a simple Thomson recording wattmeter with two dials, and an electric or self-winding clock. By means of the clock, the connection of the meter may be changed from one dial to the other at any predetermined hour of the day. The meter itself, shown open and closed in Fig. 1 and 2 respectively, rotates with unchanged accuracy at all times, according to varying consumption of current—but during a certain period—that during which the station peak prevails the meter mechanism is connected by a link clutch to the right hand dial and the consumption during the prevalence of the station peak recorded. As the peak in the station goes down, the link clutch is thrown over by the clock, and for the balance of the 24 hours the record of the meter is shown on the dial on the left hand side. The clock is a timepiece of high accuracy, wound half hourly by electro-magnetic means, the necessary energy for this being derived from the circuit on which the meter is installed. A setting mechanism allows the clock to be set at the time of day the meter is installed, while another mechanism regulates the movement of the link clutch to correspond with the periods of the station peak. The central station is thus in a position to learn exactly how much current has been consumed during the hours of maximum demand, and how much at other times, charging a high rate for the energy recorded on the right hand dial, and a low rate for the record on the left hand dial.

It will be seen that the two-rate system is based entirely upon the condition of the station—that of supply and demand, and not

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upon any conditions local to the consumer. The condition of the load on a station using two-rate meters is also shown by the curves, (Fig. 3). With the discouragement of local peaks coinciding with the main station peak—the really objectionable peak, is a steady stimulation to creation of local peaks not occurring at the same time as the station peak and this, putting a premium on heavy consumption when the station is lightly loaded, not only breaks down the main peak, but also tends to build up the average station line by the introduction of the local peaks. It does not, however, discourage the small consumer, since he benefits as much by the low rate during the period of minimum demand as does the large consumer. He is encouraged in the same ratio, and securing his current cheaper is prone to increase his consumption, tending to raise the average load line of the station. The heavy line in Fig. 3 shows the result which will probably be obtained.

Argument has been made against the two-rate system on the basis of the premises that no business is obtainable during the "valley" hours, i. e., the hours non-coincident with the peak. Now, if the gas curve of any city during twenty-four hours be reduced to a unit common both to electricity and gas—say, candle hours—and be then superimposed on the output curve of the electric station for the same twenty-four hours, calculated in the same unit, it will be found that, while the general shapes of both curves closely coincide the total area of the gas curve is so much greater than that of the electric curve, if the "valley" portion of the gas curve could be taken away from the gas, as it could by arrangement of price charged, and added to the corresponding period of the electric curve, the "valley" in the latter would be built up. So much so, indeed, that the "valley" would be but little lower than the peak. This fact alone would tend to prove conclusively that during the "valley" hours, there is much available business obtainable, provided, of course, the inducement of price be made sufficiently attractive.

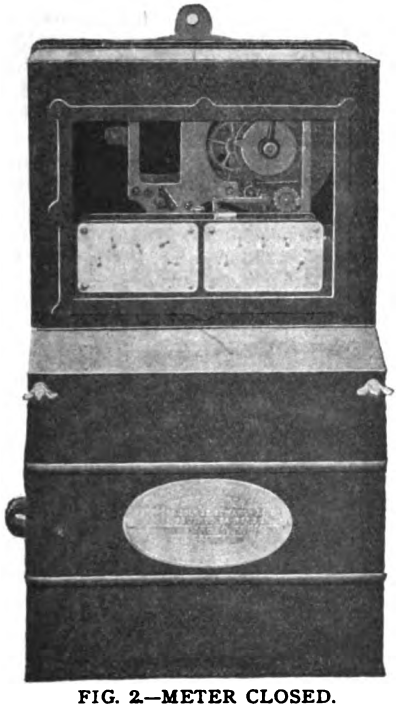

FIG. 2.—METER CLOSED.

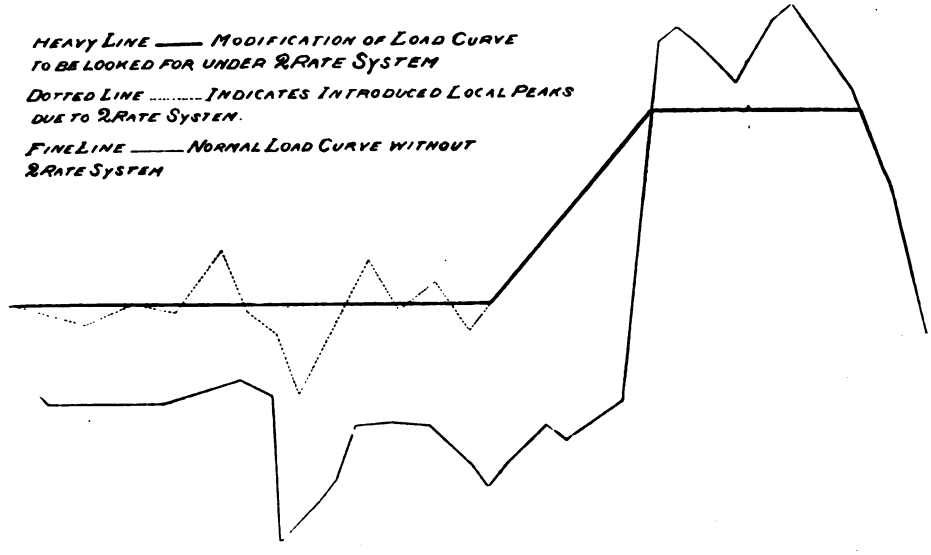

FIG. 3—LOAD CURVES WITH AND WITHOUT THE USE OF THE 2 RATE SYSTEM.

The two-rate meter system is just as desirable for, and may be applied to, direct or alternating current circuits, but the meter is not interchangeable, direct current meters being used for direct current circuits—alternating current meters for alternating current circuits.

Two examples of the influence of the use of the two-rate meter system in station pratice may be mentioned: First. One large and influential station which has only recently adopted the two-rate meter, has not only added over $20,000 worth of new business on the two-rate basis, but has also, and this is noteworthy, reclaimed $10,000 worth of old lost business from the gas companies.

Second. In cases where a consumer uses incandescent lamps, motors and incandescent arc lamps, he is usually charged a different rate for each character of service, i. e., one rate for the incandescent lamps, another for the power service and still a different rate for the arc lamps. Each service measured separately requires a separate meter. These three meters could be successfully replaced by a single two-rate meter with consequent diminished expense to the station, and, very probably, greater satisfaction to the consumer.

Why Some Small Electric Light Plants Do Not Pay.—I.

BY J. R. CRAVATH.

TO the men who have always devoted their attention to the affairs of large lighting plants, the close figuring and attention to minute matters that is necessary in the management of electric light plants in very small towns is rather amusing and it is apt to be thought after a brief consideration of the matter that the electric light business in a small place is a good thing to keep out of. Nevertheless the fact that there are numerous plants in towns of less than 3,000 inhabitants and that they still continue to be built and that they are many of them paying good interest on the money invested in them, goes to show that the general assumption sometimes made that no plant in a town of less than 2,500 inhabitants will pay, is far from the truth. As a matter of fact there are plenty of paying plants in towns of 1,200 to 1,500. My observation has led me to believe that where plants do not pay in prosperous towns of 1,500 and upward, it is usually not so much the fault of the technical or engineering end of the plant as it is of the common sense business end. To be sure there must be a knowledge of the technical end combined with the business management, but the failure to pay dividends is usually fully as much or more with the business management than with any engineering defects in the plant, as in such small plants the engineering part is "cut and dried" practice as it were. However, as there are some inexcusable engineering blunders made even in such small plants, and as they are usually made when the plant is first constructed, a discussion of why some small electric light plants do not pay can only be entered into fairly by discussing both the engineering and business management from the time the plant is first financed to the time it is fairly in operation.

One of the first common mistakes in building a plant in a small town is to start with too little cash in the company treasury, or at least not enough provided for to properly get the enterprise on its feet. It should never be forgotten that in starting to light a small town, as in many another business enterprise, it will take some time to develop the business. While, after a year or two of operation the returns should be considerably more than the ordinary 5 or 6 per cent. on an investment, the first few months will not do much more than pay the operating expenses, to say nothing of interest on money borrowed to build the plant with or bills for construction material from electric supply houses. The promoters may think that if they can only get together money enough to get the plant started, somehow they will be able to pay for it out of the earnings. That is all very nice providing they can borrow money on long time loans and borrow enough to

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pay for the many expenses in the way of extending lines, adding new customers and paying interest the first few months after the plant starts. By far the most satisfactory way, however, is to start with enough paid-in stock not only to start the plant but to pay for extensions and improvements for a year or two after it starts. In other words, put the cost of construction where it belongs and pay for it out of the capital stock of the company, instead of loading it on the operating expenses of the first two years and giving the whole enterprise a black eye both in the eyes of stockholders and public, because it does not pay expenses. Of course, theoretically, it makes no difference where the money comes from to pay for the plant, whether out of operating receipts or paid-in capital. Practically, the gross receipts will not be more than enough to pay a small interest on the investment at first, if they are even enough to do that, and an attempt to not only pay running expenses but construction expenses out of gross receipts is foredoomed to failure, and the moral effect of this on the standing of the enterprise not only among outsiders but among stockholders, is something to be avoided. Let there be money enough to do the thing right from the start, let it be understood among stockholders that returns are not to be looked for the first few months, but may be counted on with certainty once the company is fairly started, and we start out with little chance for the dissatisfaction and loss of confidence that sometimes handicaps the small plant.

Once the financial problem is out of the way and money provided for, there are a number of ways, both successful and unsuccessful, to go about building the plant, as the results all over the country to-day testify. Here, too, a level business head is needed as much as anywhere else. We see statements often in the technical press from which one would gather that it is only necessary to hire a consulting engineer and the work will be done perfectly. Contracting firms would make one believe that it is only necessary to give them the contract for the whole thing and all will be right. Then there is the man with second-hand machinery who will tell you how to do the whole thing if only one will purchase of him. Now, I am not prepared to say that any of these methods are all right or all wrong. It takes a conservative, level business head to see the correct way whichever method is pursued. It is surely not good business to deal with technical matters one is not familiar with, without the unprejudiced advice of some one conversant with such matters, nor is it good business sense to seek such advice without being sure it is honest and competent. Neither is it always good business sense to attempt the assembly of all the apparatus that makes up a plant, when reliable contractors skilled in the business can be found to undertake it, at a reasonable price. Last of all, I certainly do not consider it a necessity at the present time to purchase new apparatus all through for a small village plant. Second-hand apparatus, however, is something which should only be "taken in very small doses, and under the advice of a competent physician." In this matter of second-hand apparatus there are many things to be considered. It is usually the case that cheapness and reliability stand above all else in the very small plant. In such plants the alternating system will be generally used, and as the generating outfit will comprise one engine and one dynamo it is important that they be in such condition as to be able to give regular service with no shut-downs for repairs. Owing to the enlargement of many plants, a large number of second-hand alternators of small capacity have been thrown on the market at a very low price. Many of these are almost as good as new and offer the small plant a chance to make a considerable saving in investment with practically no drawbacks, if the machine is carefully selected. Second-hand engines can also be bought that will give excellent service if thoroughly overhauled as to all bearings, pistons and valves before being put in service. Leaky insulation in the dynamo and leaky valves and pistons in the engine are the things to be looked out for mainly in the purchase of these machines second-hand. As to second-hand boilers, the electric light man should be exceedingly wary and only purchase after a rigid examination as to quality of metal and incipient defects. Most boilers are not worth resetting after a few years' use with the scale-producing water that abounds in most parts of the country. While an engine or dynamo can usually be repaired or overhauled in a few hours between runs, boiler repairs usually require several days, and it is therefore important that there be no boiler repairs if the plant is to run with one boiler. And this leads up to a mistake that is often made in the construction of a small plant, namely, the attempt to get along with one boiler in a locality where the water scales boilers very badly. It is comparatively safe to count on one boiler as on one engine and one dynamo if the water is good and does not leave any hard scale on plates and flues, but it is flying in the face of fate to count on obtaining unbroken service day after day for years from one boiler if there is any tendency on the part of the water used to form hard scale. Many a plant has come to grief from this cause. If one boiler only is put in the tendency constantly is to neglect the thorough cleaning of it and in fact there is not time between daylight and dark to cool down a boiler so that it can be properly cleaned. Some inaccessible place will get heavily coated and then it is only a question of time until leaks and shut-downs will follow. Therefore always make provision for putting in two boilers even if the plant is to be started with but one. It usually costs no more to build with a view to increase of boiler plant, and yet it is extremely common in the smallest plants to see no provision whatever made for it and an arrangement of building and coal storage which makes the addition of another boiler a matter of turning things wrong side out to accomplish it. To return to the consideration of how far it is best to invest in second-hand apparatus, the strongest temptation of all will be to save investment by getting all second-hand transformers. A great many good engineers familiar with all the modern ideas as to the great core loss in aged transformers will hold up their hands in horror at the mere mention of the possibility that second-hand transformers could be used. There are no doubt many transformers to be had both new and old that are expensive at any price. There are, however, many transformers of good make thrown on the second-hand market because of the increasing custom of bunching customers on larger transformers as practiced by large plants. These discarded transformers may have lost some efficiency through the ageing of the iron, but the probabilities are that they are still more efficient than some makes of new transformers, and certainly the regulation is as good as it ever was. A good second-hand transformer is certainly to be preferred to a poor new one. For the few moderate sized transformers that run the store lights in a small town the matter of efficiency is not of great importance because the transformers are few in number and are run most of the time near full load, as the smallest village plants only run the first half of the night. For the scattered residence lighting, however, efficiency is of great importance, because it is impossible to bunch many customers on the secondary of one transformer, and as there must of necessity be many small transformers, the leakage current and watts lost in heating transformer iron will be considerable. It should not be forgotten, however, that the short run (averaging six hours per day) of the small village plant, tends to make the matter of core loss in transformers relatively of less importance than in a plant run twelve or twenty-four hours per day. In my opinion, it is safe and good policy to buy second-hand transformers, provided they are put through the same tests and made to answer to the same specifications as new ones would be.

The transformers that go into small plants are rarely tested in any manner, but at the present day there is no reason why they should not be put through some simple commercial tests before being accepted, since the necessary instruments are now within the reach of all plants at a reasonable price. No transformer should ever be put on any line that drops more than three per cent. in voltage at its secondary terminals between no load and full load. This is easily tested at any village plant by measuring the voltage at the secondary terminals of each transformer with and without load, the primary voltage being kept constant. And I may say here that a portable alternating current voltmeter should be a regular part of the equipment of every plant of this kind, although as a matter of fact small plants having them are very scarce. Implicit faith is usually placed in the station voltmeter, and it is religiously kept at a certain point, regardless of what the line drop may be and regardless of what the error of the instrument may be, but this is another subject and I will speak of it later.

Electric Lighting Competition at Canandaigua, N. Y.

On Oct. 7, 1898, M. D. Munger, former president of the Canandaigua Electric Light and Railroad Company presented an application to the Board of Trustees of Canandaigua, asking for an electric lighting franchise. The trustees held several meetings to consider the question. Taxpayers and interested persons argued for and against, and after careful consideration the trustees refused to grant the desired franchise on the grounds that

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the present company was giving good service and that it was not for the best interests of Canandaigua to permit ruinous rivalry.

Izambard Process of Printing by X-Rays.

George Izambard, who has been experimenting in Paris with the Röntgen rays in the hope of adapting them to commercial use in the printing industry, announces that he has succeeded in producing a machine for the purpose. He reasoned, it is said, that if the X-rays would penetrate oaken logs they ought to penetrate piles of paper, and that as photographs could be taken with X-rays, it ought to be possible to reproduce a picture or printing through every sheet of a pile of paper. The invention is so far matured, that, according to some of our exchanges, M. Izambard is able to expose a pile of paper between two Crookes tubes and print both sides of all the sheets in the pile at the same time. He can also place a series of piles of paper around a Crookes tube, making use of the X-rays by radiating them from a centre.

It was suggested many years ago that the printing of the future would be done by electricity, operating, not on single sheets, but on all the sheets of a pile at the same instant. Various inventions have made some approach to a solution of the problem, but none of them has been successful in producing satisfactory printing. M. Izambard's first success was obtained by sensitizing the paper, on the side that was to be printed, with a gelatino-bromide emulsion, such as is commonly used in photography. A pile or block of paper thus prepared was placed in a position of exposure to the X-rays. On top of the paper was placed a copy of the thing to be printed. This copy being proof to the X-rays, in a trice the thing was done, and on developing the pile of paper the inventor found a copy clearly printed on each sheet.

To print in this manner, it is necessary that the copy or original shall be nearly impervious to the Röntgen rays and that it shall be placed between the Crookes tube and the pile, where the rays may be directed to it. The copy is preferably first printed or written in what is called radiographic or X-ray proof ink, composed of a material calculated to intercept the rays. A few seconds' exposure is sufficient to effect the printing through the entire pile of paper, but it is at first invisible and requires to be developed or fixed, after the method of a photographer. The piles of exposed sheets are trundled into a red-light room and suspended in vats, where the developing and fixing liquids are applied. Rinsing and drying follow, and the latter may be hurried by mechanical and chemical means. It is apparent that the process is really a sort of wholesale method of photography with the X-rays, and is printing only in the photographic sense of the term.

The inventor admits that there is a difficulty in printing on one side only of the paper, owing to the tendency of the print to show through on the reverse side. He proposes to overcome this by sensitizing the paper in stripes, printing the lines on the stripes, and causing the lines on one side of the paper to fall opposite the spaces between the stripes on the other side. Until he can improve upon this method the process must be limited by these restrictions. To offset this drawback, there are peculiar advantages in the process. It is just as easy to print in white on a black ground as is black on a white surface. Typewritten matter can be reduced in size and reproduced, thus saving the expense of composition.

For printing very large sheets, such as newspapers, M. Izambard uses several Crookes tubes, which are shut off from one another by partitions of a metal not easily penetrated by the rays. Thus the tubes send their rays through the paper in nearly straight line. The limit if thickness of the pile that can be printed at one exposure is reached when the rays are so distributed as to distort the image. Probably no pile of more than a couple of inches in thickness could be impressed at a single exposure with satisfactory results.

The X-ray proof ink used is made in part of finely divided metallic or calcareous powder. Bronze, copper, white lead or white zinc may be used. As a writing ink white lead in a solution of gum has been found most satisfactory. When the matter to be printed is first typewritten, the metallic powder is mixed with boiled linseed oil.

A peculiarity of this X-ray printing is that it affords opportunity for printing copies of private or secret matter, without the printer's being able to see or read what he is printing. A customer desiring copies of private matter may deliver his copy written in the X-ray proof ink and securely sealed in an envelope. He may also see that the paper on which the copies are to be printed is securely sealed. Then the printing may be done by the X-rays and the developing executed without once breaking the seals, so that no one through whose hands it passes can know the contents. If desired, the envelopes may even be made of stout canvas or leather and securely locked.

How Welsbach Lights Were Adopted at West Haven, Conn.

A statement was made recently in the newspapers that Welsbach street lights had been adopted at West Haven, Conn., in place of the electric arc lights. A correspondent writes us as follows about the matter: Replying to your inquiry about the West Haven Welsbach lights, I can only report that the New Haven Electric Co. were not even asked to quote a price, nor in fact knew anything about the matter until after the contract for Welsbach naphthas had been out. As I get the report from prominent West Haven people, the warden called a citizens' meeting a night or two after he was elected; but not specifying the purpose of the meeting, it was attended by only about twenty-two of the people of West Haven, and those not taxpayers. At that meeting he had a vote passed, by his adherents, authorizing the warden to contract for Welsbachs. Two days later he called a meeting for the burgesses, at which he had the agent of the Welsbachs. Before that meeting, and the first thing read, was a petition and protest from the principal taxpayers, calling for a second meeting of citizens to reconsider his vote, and protesting against the removal of any electric lights. Paying not the slightest heed to this, and going directly against the expressed wishes of the larger and most influential taxpayers of the village, he then and there signed a contract for the Welsbachs. Afterwards, the contract having been signed, he called a citizens' meeting, reported what he had done, and had his action ratified, many voting that way because he had completed a contract, and that any contrary action would now only involve the borough in a lawsuit. West Haven is full of rumors as to the warden's reasons for his action, but these will have little interest for you.

National Municipal League.

The National Municipal League will publish, early in January, 1899, the "Proceedings of the Indianapolis Conference for Good City Government." This volume will contain the report of the Committee on Municipal Programme, which has been so widely and favorably commented upon by the press of the country. This committee, which consists of Messrs. Horace E. Deming, Charles Richardson, George W. Guthrie, Dr. Albert Shaw, Clinton Rogers Woodruff and Dr. L. S. Rowe, devoted about eighteen months to its report. This volume will include all of the formal papers submitted with the Report, as well as the specially prepared papers by well-known students of the problem. Among those contributing to the discussion are: Mayor Quincy, of Boston; Mayor Jones, of Toledo; John A. Butler, president of the Milwaukee Municipal League; C. S. Palmer, of Kansas City; Dr. E. W. Bemis, author of "Municipal Problems;" Delos F. Wilcox; E. J. McDermott, of Louisville; Lucius B. Swift, of Indianapolis; N. F. Hawley, secretary of the Minneapolis Charter Commission. This volume of proceedings, with the previous volumes published by the League, form what may be justly termed the most important recent contribution made to the subject of municipal government in this country. The new volume of proceedings will be published in cloth at the rate of one dollar per volume. Copies can be had upon application to the chairman of the Publication Committee, Clinton Rogers Woodruff, 1112 Girard Building, Philadelphia.

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THE

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The Practicability of Electrical Apparatus for Naval Warfare.

THE paper by Mr. F. W. Roller, printed in this issue, on the performance of electrical apparatus on shipboard during the war with Spain, is one of the most interesting and pertinent contributions on the subject. Its author evidently made good use of excellent opportunities, and has been able to favor the New York Electrical Society with a series of observations and suggestions that cannot but help to secure improvement in many needful respects.

The value of the searchlight was well proven at Santiago. It was the real cork in the mouth of the bottle, and prevented Cervera from slipping out at night, when alone he could hope to escape. But Mr. Roller says that he is not aware of any attempts made to signal with the searchlights. This is certainly curious, if true, for that is one of the first uses suggesting itself to a bystander; but the reason may have been the obvious fact that the enemy could also see the flashes and beams. It does not follow, however, that he could interpret them. As to the signals with incandescent lights, there were, it is plain, none too many of these available for Ardois work. The result in one case noted by Mr. Roller was that the captain of an auxiliary vessel fired on a consort because there was no time to "go through all that lantern business" with oil lanterns.

Mr. Roller, turning to more delicate apparatus, records some poor results with electric firing arrangements on rapid-fire guns, "undoubtedly due to the low battery power furnished to set off the primers." This is not surprising when you learn further that the battery power consisted of two or three cells of ordinary dry battery in a metal case exposed all day to a tropical sun! The wonder is there was any current at all under such absurd conditions. Such treatment is not fair to the method, and while perhaps not attributable to carelessness does suggest the need of more competent supervision by officers who know what to do with apparatus.

One other point we must touch on in Mr. Roller's admirable paper. He speaks of the electrical range-finder, and after discussing adverse conditions, says: "Under the circumstances, it is natural that its use should have been largely abandoned." Now, we have been making inquiries on the subject and are rather startled at what we hear. Any one would infer from the above remark that these range-finders were tried in the war and then given up. If what we hear is true, not a single electrical range-finder was tried at all! There was one mounted on the "Cincinnati," but it does not appear to have been used. The "Brooklyn" had one, but it is said that it was never mounted even, and that no attempt was made to utilize it. We cannot vouch for this, but we have it on good authority.

Soon after the first reports of failure of the electrical range-finders, in the early stages of the war, we wrote to Lieut. Bradley Fiske, of the "Petrel," on the Philippine station with Admiral Dewey, inquiring for the causes of it. We have since heard from him at Yokohama and gather that he is rightly sceptical on the subject. The newspapers talked of the bad effect of heavy gun fire on such apparatus. The effect could not have been very bad on apparatus that was not set up, and Lieut. Fiske says: "I have believed that although the parts of the apparatus were small and delicate, they were also light; and, by reason of their lightness and consequent small inertia, would receive small shocks from any concussion." He based this belief, it appears, not only on theory, but on experiment. For example, putting a Weston millivoltmeter alongside an 8-inch gun, when it was fired, the instrument bounded up in the air two or three inches, but was absolutely uninjured and the indications were unchanged. In fact, Lieut. Fiske goes so far as to remark: "My last information is that the firing of the guns had rather a beneficial effect than otherwise on my apparatus, because it overcame a tendency of the small moving parts to stick." This strikes us as very reasonable.

Lueger's Fiasco.

ATTENTION was called in these pages a few months ago to the vagaries of Burgomaster Lueger, the anti-semitic mayor of the fair city of Vienna. He had started out on a grand anti-everything programme and had proposed municipal ownership on the grand scale. His chickens are now coming home to roost in the shape of ostriches, and the state of affairs in Vienna is a precious example of how not to do it. His most conspicuous blunder has been the construction of the municipal gas works. He could have secured the entire works and plant of the Imperial Continental Gas Association for 16,000,000 florins, but his new municipal works will cost 40,000,000 florins. They are wretchedly planned and worse executed. There is great fear of a breakdown next October, when the new lighting is to come into use. Main pipes have been found to be cracked, and have had to be replaced by better ones; whole streets have been dug up a second time because the pipes were not lying on a solid foundation. The lamp posts put up throughout Vienna, besides being ugly, are so weak that several of them have been knocked down by passing vehicles. The streets of Vienna are in a disgraceful condition. The finances of the town are so heavily encumbered by new institutions created to provide posts for certain councillors that sanitation, cleansing, and education have had to be neglected, and the result is that the rates are being increased, local trade and industry are suffering heavily from the class hatred in the town, and the general condition is one of profound dissatisfaction and anxiety. We are often referred to Europe to show us how municipal ownership there works to a charm, but Vienna must not be overlooked as a sad example to the contrary, any more than Manchester, where the municipality itself is putting in the overhead trolley on a vast scale at the very moment when in New York City private enterprise is spending millions on under-running conduit systems, which leave the streets absolutely bald of wires.

Educational Problems of the Hour.

AMONG the leading questions that relate to American expansion and export trade is that of technical education. Although it is a cheering fact that due to the inventiveness of the nation, the export trade in manufactured goods has taken an enormous development, it is an evil to be corrected that there is such a terrible scarcity of technical, manual and trade schools. We are not greatly surprised at the large numbers of "foreign" workmen in American shops. This will last as long as the country receives and invites immigrants from Europe, but there must surely, if we desire the continued expansion of American trade, be a growing proportion of American-born artisans. We cannot but draw attention to the recent report of an English commission which had been sent to Germany to inspect and report on German industry. They were of the opinion that compared with the intelligent, skillful and frugal German workmen, the English factory hands were like "semi-savages"—a rather severe statement. A recent consular report on "foreign trade policies," commenting on the work of this commission, states that "this (technical education) is a most important question, in that the great improvement in the quality of German manufacturers, is to no small extent due to the fine technical schools of Germany. Eight of these schools are mentioned in the report, all which are supported by their

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respective State Governments. The results of this technical education are set forth in the following commendatory words:

"The establishment and constant improvement of these technical and trade schools have revolutionized the scientific industries of Germany, which have outstripped even those of Great Britain and France. The workman in Germany is now in most cases a scientifically, as well as a practically, educated man, and the result is that his handiwork has improved a hundredfold. The great increase in the amount of German exports in this field can be ascribed in a large degree to the technical and trade schools, which have, in fact, made Germany in a manufacturing sense what she is."

Turning then to our own achievements in this line of public duty, we are confronted by a lamentable state of affairs. Well endowed and equipped scientific schools for the training of engineers, we have by the score, offering splendid opportunities to those who can devote four years to the study of their profession and can afford to pay the tuition fee and support themselves while pursuing their studies. But how about the thousands of able and intelligent young men in all walks of life all the land over, to whom the privileges of a college education are denied and who, notwithstanding their humbler station are very often found to possess greater natural talents for becoming successful electrical engineers than some of their more fortunate brethren at school and college? Night schools have attempted to fill the gap and have failed to meet the want, because they have too often trained the mind and neglected the hand, giving their pupils a systematic theoretical training, but leaving their practical ideas in a chaotic state to be arranged, perhaps, by observation in the shop at a great expense of time and energy.

What is needed in order to train intelligent workmen are trade schools fashioned after the splendid "Gewerbeschulen," of Germany, schools which open opportunities to all classes of ambitious young men during day and evening for acquiring a thorough understanding of the theory and practice of their chosen trades. We know at present of but one tschool of this type, namely, the New York Trade School, founded in 1881 by Col. Richard T. Auchmuty. It is the purpose of these schools "to enable young men to learn the science and practice of certain trades thoroughly, expeditiously and economically, leaving speed of execution and experience to be acquired at real work after leaving the school." It also enables a young man to quickly determine whether he possesses an aptitude for a certain trade.

Judging from the interesting description of the work of these schools given recently by Mr. Arthur A. Hamerschlag before the A. I. E. E., the instruction imparted to young men in that institution is practical, thorough and up-to-date. The electrical course in particular impressed us as being well planned, and should make the youths who are graduated from it better workmen.

Mr. Hamerschlag deserves great credit for inaugurating so practical a system of teaching electrical journeymen, and we trust that more electrical trade schools will soon be founded, and that the Institute itself will take this matter of education in hand and give it its careful consideration. It cannot be denied that next to the education of the electrical engineer himself comes the training of those men who execute his plans, and into whose hands he so often entrusts his professional reputation.

But even trade schools, should they be established in large numbers, couldn't fill the want of thousands who, for various reasons, such as lack of time, age, place of residence, home relations, etc., could not attend a school, but are eagerly seeking an electrical education. As pointed out by Mr. Hamerschlag this field is thoroughly covered by various correspondence schools. The phenomenal success achieved by such schools in a short period of time, by enlisting as students men representing all branches of the electrical and other engineering professions, from the bell hanger to the college professor, and the fact that some of the most prominent engineers and specialists have prepared the instruction papers, shows that the right course has been pursued, and that there are thousands of men eager to be better educated if the matter is presented to them in a proper and attractive manner. They also prove that it is recognized by the layman as well as by the specialist that the field of electrical engineering offers to its followers brilliant opportunities, quick advancement and often great pecuniary reward. The civil engineer, the architect and the steam engineer, who to-day lack at least a working knowledge of electricity, are behind their times. Every industry has been influenced since the general utility of applied electricity became recognized, and electricity is veritably becoming the driving power of the wheels of commerce.

Arc Carbon Manufacture.

THE consumers of arc carbons throughout the country, and especially the local lighting companies, will be greatly interested in the announcement made in our columns this week of the organization of the National Carbon Co., of New Jersey, which is to control the electric carbon industry in this country. According to the reports given out this new concern is an enlargement of the older one we are all familiar with, taking in some companies that have been "independent" and adding them to those already within the combination, and subordinate to the National Carbon Co., of Cleveland, which perhaps has never yet developed up to its full capacity. The new National, now accomplished, is understood to have a capitalization of $10,000,000, of which $4,500,000 is non-cumulative; the remainder, $5,500,000, being common. With good prices for carbons, it should be easy to earn the $315,000 annual profit for the 7 per cent. preferred stock, and leave something for the common. Carbons have been sold too cheaply, and prices may now improve, but it is possible that economies in management would render this unnecessary, and therefore more competitive capital would not be invited later into the field.

The arc carbon industry has seen many changes, but none more remarkable than those which have brought the price for "points" from $60 per 1,000 down to about one-sixth that price. It has been estimated that during the past 15 years, some 75 carbon factories have been started here and in Europe, with a capacity reaching 600,000,000 of carbons a year. We doubt whether the consumption exceeds half that. The American factories which have gone into this consolidation and which will naturally try to control the trade for the present in this country. have, it may be figured, a capacity of 450,000,000 a year, so that even a large growth of arc lighting can be taken care of very comfortably without expenditure to increase capacity; while the hand processes of manufacture which once numbered 30 or 40, are already a bare half dozen.

Automobile Ice Wagons.

THE rapid tendency towards the adoption of automobiles is not shown merely in the fact that it was the correct thing to go to Mrs. Astor's ball this week in an electric carriage, but in the industrial fact that the Consolidated Ice Co., of this city, is seeking to change the motor power for its ice delivery wagons. It hopes to be able to dispense with the use of a large number of its 3,000 horses before the rush of the summer trade begins. The company requires 1,000 horseless wagons, and has invited proposals for plans of construction. The routes traveled by ice wagons in this city average ten to fifteen miles, and the suburban routes twenty to twenty-five miles a day. The weight of an empty ice wagon is about 3,500 pounds, and they are capable of carrying from six to eight tons of ice each. The work in hot weather is particularly trying to the horses, they are short lived, and the cost of replacing them is heavy. This is altogether an interesting proposition, and there is no reason why the ice company should fail to secure a good type of wagon. It is true that the roads such wagons go over are often bad, but when French automobiles can go to fox hunts and paper chases, that ought to be no serious objection. As to weight, that again is not an insuperable difficulty, being simply a question of adjustment to the work to be done. Among the automobiles now in use are doubtless many that do an equivalent duty to what is here required.

We are not prepared to say that electricity will prove the best motive power for this work, although it certainly has many recommendations, especially for city work; and it is to be hoped that it will be given a fair trial. Perhaps there is an opening here for the new compressed air trucks, but under most conditions an ice wagon would be the very last place to try compressed air or steam or naphtha.

Anyhow, we hardly expect to see the Consolidated Ice Co. equipped this summer. We do not know of any factory that has the proper design yet and the full facilities, and all the electrical automobile shops are busy up to their top notch. Indeed before the ice company gets fully going without horses, it may wake up one morning in the near future to find all the refrigeration in the city done by liquid air delivered in little cans by electric automobiles as dainty as those that Gorham and Altman are using for their bonnets and jewelry.

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MISCELLANEOUS

Some Remarks on the Performance of Electrical Apparatus on Shipboard During the Late War with Spain.[1]

BY F. W. ROLLER.

IN addressing the Society this evening let me preface my remarks with the statement that much of what I shall have to say is based on hearsay evidence as is necessarily the case, but that the opinions of the numerous other officers with whom I have spoken on the subject seemed to agree so well that I believe you may take the conclusions as generally correct.

In the first place we will divide the electrical appliances that we had into two different classes and compare them. The first of these will include the indicating apparatus, such as the engine room and order telegraphs, speed and direction indicators, helm angle indicators and the range finder. All of these instruments are of the galvanometer type, there being a galvanometer at the receiving end, with its scale divided in yards range, degrees, revolutions or arbitrary orders instead of volts or amperes, and actuated by differences of potential produced at their terminals from the sending end. They are in consequence delicate in construction and easily get out of adjustment, but they have the advantage of flexibility and possibility of the use of a large number of receiving stations, as well as the minor one of requiring inappreciable amounts of energy.

In general it may be said that their performance was not satisfactory. In some cases, say that of the range finder, the trouble cannot be attributed entirely to electrical reasons. In this instrument, where we in reality measure the altitude of a triangle from the known base line (the distance between the two telescopes), and the angles adjacent thereto (those made by the telescopes with the base line when bearing on the target), the base is so very short in comparison to the other two sides, that unless the glasses are very carefully trained and the whole apparatus is in perfect adjustment, a very considerable error will arise. It is easy to see how large this error may be when we know that the glasses could only in the most advantageous cases be placed as far as 300 feet apart, and that the minimum distance from the target that it is likely that they will commence to be used at is 3,000 yards, the altitude is here thirty times the base. In addition to this I understand that the device in several cases proved to be unable to withstand the concussion of the great gun fire. Under the circumstances it is natural that its use should have been largely abandoned and instead the secondary battery used. With the great rapidity of fire of this, it was easy to take a large rapid-fire gun, load with common shell, estimate the distance by eye, run up the sights for that and fire. If a hit was made, that was the range. If not, the shell would be seen as it struck the water, the sights readjusted accordingly and, the gun having been reloaded in the meantime, another shot taken. It was rarely necessary to make more than two or three trials of this kind before the range was had to a nicety, and then the main battery could be opened up.

But let us return to our subject of the instruments. They had another feature that contributed to their lack of success, which was the difficulty of locating any derangement that might arise. The men were used only to mechanical devices and a fault that could neither be seen nor detected by the ear, seemed to them most mysterious, outside of the fact that the testing even when understood was none too simple and was rendered still more difficult by the surrounding conditions. As a consequence but few troubles made them disgusted, and the instruments got the reputation of being far worse than they were.

There is one other class of electric device that can be said to fall in this first class in that it employs currents of small strength. This is the electric firing arrangement that was used on some of te rapid-fire guns. But few of the ships are fitted with this. The "Nashville" was one, and although we had, on the whole, the most satisfactory results from it, two or three of the others had, I understand, some trouble from miss-fires. This, however, was undoubtedly due to the low battery power furnished to set off the primers, there being a little case holding three small sized dry cells secured to the gun mounts, which were supposed to give all that was required. They did give it, as a rule, but dry batteries are not any too reliable any way, and standing exposed in a metal case to the intense rays of the sun, day in and day out, did not tend to help them any. A more powerful type of cell would undoubtedly render them perfectly certain in their action, and as the breech plugs fitted for electric firing are far more simple mechanically than the other types, there is little doubt but that they will be permanently retained.

Leaving now our first general class we come to class number two. This includes all appliances requiring considerable amounts of current for their operation and takes in the incandescent lamps, the searchlights and the motors.

It may appear strange that special stress should be laid here on the incandescent lamp as its advantages seem obvious, but it is of extreme value in many ways that are not so apparent at first glance. If we take the easy control of all the lights from a central point for instance, here alone is a point of the greatest importance. On a regular man-of-war all of the lights that are out of sight, and those necessary for the operation of the guns at night (which are fitted with shields to obscure them), are grouped on a common "battle circuit;" so that under war conditions all of the other circuit switches may be opened at sundown with the perfect assurance that after that there will be no glimmer of light to betray the vessel's position. On the auxiliary vessels that we had there was no such provision with the consequence that in spite of the vigilance of the officers they were bound to be found sooner or later with an unauthorized light going somewhere.

It was easy then to see them at quite a distance and an enemy's ship would have had a great advantage over them whether she was chasing or trying to slip by. Another place where the electric light was practically indispensable was for the night signal work.

The regular ships were, of course, fitted with our standard "Ardois" sets, which consist of a string of five lanterns, each half clear glass and half red, inside of each of which were two lamps either of which could be lit independently, and, by means of a keyboard, the different combinations that formed the signals made. These were always ready, and it was but a second's work to flash the private signal at any craft that was deemed suspicious before betraying your own position too markedly by turning on the searchlights, or going further and opening fire. The other ships had to have a number of ordinary lanterns ready lit, concealed from observation, which they would bend on a pair of signal halliards and hoist when they had a communication to make; an operation requiring considerable time. That this time element was important is illustrated by an incident which came under my observation while on the Havana blockade in the early part of the war. There the captain of one of our auxiliary vessels fired on another one of them one night, fortunately discovering his error before any harm was done. He explained his action the next morning by stating that he only saw the other craft when she was very close to him and thought that she was something trying to get in; that that was "no time for signals where he had all that lantern business to go through, so he fired first and asked questions afterwards."

We now come to the second device in our class two, the searchlight. The value of this was proven beyond all possibility of doubt in this war; not only was it valuable, but I think we can go much further and say that if it had not been for it there is a strong probability that the war would not even yet be over. We learned afterwards that at Santiago, leaving aside the practical certainty of night attacks from the harbor of the enemy's torpedo boats, which would have stood an excellent chance of success, Cervera had fully determined to make a night dash to escape. This was rendered an impossibility by the searchlight beams that were kept on the harbor entrance the night through, which made the place as light as day for the ships that were behind the lights and simply dazzled the eyes of any attempting to get out, rendering the navigation of the tortuous channel exceedingly hazardous, and making shooting practically impossible for them. In consequence, he found it on the whole, better to make his trial in daylight—with the well known result. If a night run had been feasible owing to the lack of the searchlight, there is a strong probability that the majority at least of the Spanish ships would have got away clear, and if they had succeeded in making Havana, their dislodgement and the capture of the town would have been a problem of a far different and more difficult nature. An illustration of the power of the searchlight may be of interest. Of

[1] Paper read before the New York Electrical Society, Dec. 14, 1898.

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course, for the purpose of "picking up" an object they are of little use, beyond a distance of two or perhaps three miles, but the light is visible at far greater range. I have more than once when off Havana seen on the clouds the reflection of the searchlight that was mounted on the fort at Key West, a distance of over eighty miles, and not only that, but have been able to follow the course of the beam as it swung from side to side. Anticipating a query to that effect, I will say that I do not know of any attempt made to communicate with our vessels by this means.

The last of the power-consuming class, the motors, I have concluded, not to enlarge on, as you are probably all familiar with their performance, from reading the papers. The motors for ammunition hoists, turret training, ventilating fan driving, and, in some cases, steering gear, gave results so far more satisfactory than any other method of control and operation that their continued use is firmly established. The few failures that occurred were far less in number than those of their steam-driven equivalents and were even then in most cases traceable, more to the lack of familiarity of the men with their apparatus than to any inherent defects of the apparatus. It is needless to go into this any further.

As a result of the foregoing, I think we may fairly conclude that in general the devices that are included in class number one are as at present installed of questionable utility, but that class two was an unqualified success and a monument to the engineering ability of our electrical profession.

The Education of Electrical Apprentices and Journeymen.[1]

BY ARTHUR A. HAMERSCHLAG.

THE old world has given us excellent mechanics through its apprenticeship system. Unfortunately even in those countries that system is dying out. This country has never had a well-developed apprenticeship system, and to-day it has almost entirely disappeared because of the peculiar restrictions placed thereon by the unions and associations and the centralizations of the work under single financial heads, paying men by the hour or day, and whose employés shift from place to place as the demand for their services varies from busy to dull times. In fact, to-day the apprenticeship system is almost impossible for financial and other reasons, so we must devise some other means of educating the youth who wishes to enter the electrical field.

It is true that three or four of the largest electrical concerns do apprentice young men, but the number is comparatively small, and it requires considerable influence to secure such indentures. The number of applicants is, however, out of all proportion to the number that can be accommodated, and such openings are almost entirely out of the reach of the vast majority because of isolated locations.

Electrical work as a trade and as a profession is now undergoing the same trials and tribulations regarding the educational means that other trades and professions have undergone in the past, except that the problem in the electrical industry, owing to its rapid growth, is of vastly greater urgency. Because of this growth along scientific and mechanical lines, improvements succeed improvements so rapidly that what was considered good practice yesterday becomes obsolete and defective to-morrow. The men, or mechanics, who but a few years ago handled cleats and moldings in wiring, are to-day asked to use iron pipe and conduit, requiring totally different tools, materials and methods. And where do these men acquire the efficiency and facility for this work? They acquire it in the crudest and most uneconomical method possible, by experimently using their employer's material and at his expense in the time during which he is compelled to pay for skilled labor. These improvements certainly result in the loss of journeymen's efficiency, and in "rule of thumb" mechanics.

This type of mechanic is to be found in all trades, and sometimes he is exceptionally skilled in his work, and thus causes a tendency on the part of employers to desire more men like him, especially when he is placed side by side with the so-called theoretical mechanic who lacks the skill.

The fallacy of this reasoning is at once apparent when the "rule of thumb" mechanic comes in competition with the well-grounded and educated mechanic who possesses an equal amount of skill. Then the efficiency of the latter is so much greater that there can be no comparison.

[1]Abstract of a paper presented before the American Institute of Electrical Engineers.

Oftentimes we meet men with such a vast preponderance of theoretical training that it has removed the inherent practical skill, and this type of journeyman is almost useless when judged from the working standpoint. This latter condition is not a rare one by any means, and just a few words concerning it may be appropriate.

A glance over the list of our numerous educational institutions causes us to feel proud of our achievements in this line. In almost every settlement or city throughout the country some school, college, or university is supported upon as lavish a scale as one could desire. Endless seem the opportunities which the young American has to acquire the learning and higher education which are prized and cherished in the world to-day. We have schools for every conceivable purpose. We have colleges and universities for every profession, and we have technical institutions almost unmatched in efficiency. But we have only a very few practical trade schools, and for the education of electrical mechanics fewer still. And yet, in which field can we utilize, at present and in the future, the greatest number of skilled men in the engineering branch or in the skilled labor branch? The answer must obviously be in the latter. Still parents will persist in sending their children, regardless of their inherent qualities, to the colleges and universities to master a profession without giving a thought to the field in which their future labors must be conducted, without considering the compensation they will receive. And what is the result? There can be only one general reply.

After years of study and much money spent in acquiring the profession and an early association with children of wealth and refinement, the born mechanic becomes ruined for the sake of experimenting for a genius, or a great engineer. The field for mediocre engineers is just as narrow and confined as it is for the mediocre artist, the compensation for his labor is equally curtailed, and as a result when the young man is thrown on his own resources he must suffer that genteel poverty which his training in refined circles has bound him to. He can no longer look with pride at the work of his hands, and his brain power being but of the average, he suffers acutely, and eventually becomes neither an excellent mechanic nor an excellent engineer.

Each year the colleges and universities are sending into the world large numbers of young men, who, after years of work, take the title of "electrical engineer." How many of these will ever have an opportunity to do any genuine electrical engineering? How many of them are destined never to earn, in the electrical line, $1,000 or so a year, the pay of a skilled mechanic?

For every single opening for an electrical engineer there are a hundred openings for the skilled journeyman, and for every successful engineer there are a hundred successful journeymen.

And to be a journeyman does not mean to be debarred from engineering.

Who have made the notable inventions? Who have carried out the greatest engineering problems? Not the trained engineer, but the journeymen who have started at the bottom, and by their individual efforts raised themselves to the highest level. "By their deeds ye shall judge them" is true of men, whether they have been educated up to a high standard or not, and self-training is often the more effective.

The compensation for skilled electrical labor such as journeymen bring into the market, has been on the increase; it will continue to increase, and in an unfair degree, unless those who are the employers do not think in time of a method of supplying the increasing demand, or of making the labor which is offered worth the increase in results achieved.

Every new electrical equipment, each railroad equipped electrically, and each industry which depends on electricity is taking some of our skilled men from the open market and retaining them permanently and confining their energy to maintaining such equipment.

Whence will come the men to replace these defections? Has no one a solution to offer as to the best way of replenishing the supply?

Many methods of solving this problem have been tried, some of them without proper consideration of the case.

Some have been the education of journeymen in other trades, such as carpenters, draughtsmen, etc., by means of actual experience during their employers' time, a poor means at best, and which places the burden directly on the shoulders of the employers, while the resulting mechanic leaves much to be desired in all round efficiency.

Oftentimes young men, imbued with the desire to be electrical

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artisans, attend in a desultory fashion popular lecture courses, witness a few experiments in static and galvanic electricity, and find them of such interest that, even though they possess little or no qualifications, and have been educated and trained for other lines, they determine to make electricity their life work. Their method of securing the necessary instruction is usually a so-called apprenticeship in a shop manufacturing some article, which in itself gives them comparatively little instruction, and which makes them eventually skilled in head work, without giving them any breadth of training, and merely enables them to fill the position of a slim, automatic machine.

Sometimes they read electrical lectures and trade papers, in many instances finding themselves very much at sea, because of the technical character of the papers and articles which their previous training has done nothing to enable them to understand.

Sometimes as a final resort they become recipients of the training offered by correspondence schools, and these schools are certainly gathering an ever-increasing clientele, which their merit justifies.

In very rare instances they attend by far the best and most modern form of securing this training, and that through the trade school. There are, however, so very few of the latter institutions in spite of their acknowledged merit, and they are so little known that only a very small percentage of the number who wish to become electrical craftsmen can reap their benefits.

The superiority of the trade school for educating and equiping young men for trade work is so vastly superior to any other form of acquiring the result that to it in the future must we look to solve this very serious problem. Foreign countries have realized this fact for many years and profited by it. Is it not time that this progressive country began to realize it also, and to stimulate and support such institutions? They certainly are bound to spring into existence, and those that exist and have an honorable record are bound to improve that record, and it is but a question of time when intelligent thinkers must give them their proper place and dues.

It has been my good fortune to have been connected with trade schools for some years, notably with the New York Trade School, St. George's Evening Trade School, of New York, and the Highland Falls Trade School, of Highland Falls, N. Y. They have taught me a lesson which I hope to profit by in the future, not alone concerning the electrical industry, but concerning many trades. It is a lesson, however, which applies in an equal measure to them all. And it is that trade schools have an equally high aim and purpose as that of any educational institution in the country. That the field which they cover cannot be covered in any other way, and if they were accorded the same support and encouragement by the fraternity and public that other educational institutions receive, their effect and beneficent influence would be as widespread, if not felt in even a greater degree, because of the class which they aim to assist.

It seems strange to me that trade schools should be subject to such marked indifference by the employers and to such intense persecution and criticism by the fraternity which they aim to assist, merely because of the possible future competition their graduates will cause when they have come to the journeymen's estate.

Was there ever a scientific institution aiming at higher education, a medical college, a law or an art school, but received the support and indorsement of the leaders of the respective professions if its object was not to make money but to benefit the respective branches?

Are the prominent lawyers, physicians, artists or the men of any other profession less free from the thought of future competition than the journeymen and the employer that the latter should be found wanting in that which tends to advance his profession?

The governing societies, the trade associations, the employers' associations must see the wisdom of the trade schools eventually, and when they will realize the necessity for them, and be compelled to support them, then, indeed, will they see the error of their ways.

A society like the American Institute of Electrical Engineers, whose members comprise a very large number of the engineers engaged in electrical enterprises, can do much to bring this problem before the men of their line, and can materially assist in a solution of this problem of so much importance to the welfare of the electrical industry. The youths of the country, imbued with the desire to become electricians, will force their way in, and the inevitable is bound to occur. These young men will eventually enter the field of their choice. Why not help them and encourage them to enter under the best conditions and highest possible standard, instead of leaving them to drift in, unequipped, inefficient and lacking in essential requirements. Is it not best for them to live up to the studies exacted of skilled artisans in other lines, so that they cannot only become self-reliant and successful but reflect credit on the fraternity to which they have given their allegiance.

Trade schools have in the past done much to assist young men to acquire the rudiments of trades in other lines. They have tended to raise the standard of the individuals styling themselves helpers and journeymen by determining the capacity of the beginner, and they have put the highest premium on skill and efficiency.

What I wish to impress most seriously on my hearers is that this question of educating apprentices and journeymen bears a vital and urgent relation to the future success or failure of an industry in which we all feel commendable pride.

The New York Trade School, owing to the farsightedness and philanthropy of its founder, Col. Tylden Auchmuty, has been in the field to remedy this coming dearth of skilled mechanics and the crowding out of our home industries of the native born American workers by foreign skilled labor. Aided by the munificence of Mr. J. Pierpont Morgan and other gentlemen, it has been able to broaden its scope until to-day it ranks as the pioneer and largest trade school in the country. With its six thousand graduates it has demonstrated its utility and shown the way to those who wish to follow.

Three years ago it took cognizance of the electrical situation, and immediately inaugurated a thoroughly practical course for electrical workers, which became at once an assured success, filling the class room to its fullest capacity and having a waiting list of young men eager to enter the classes.

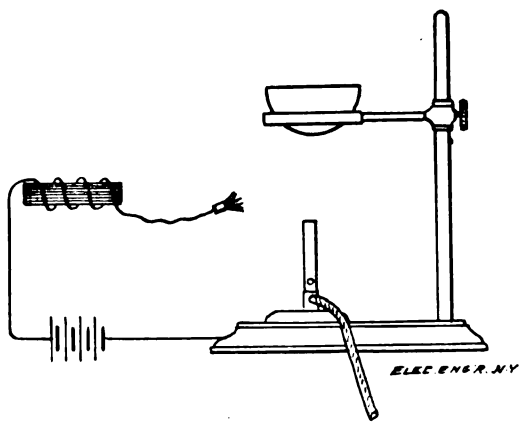
The first year the class numbered thirty-two. The second year a larger department was inaugurated, and fifty were accommodated, and still the waiting list continued to be as large. This year fifty are again at work, and fully that number were turned away. The course is thoroughly practical, because nothing is taught which is not done by the students themselves, and tested and proved before acceptance. I have appended a list of the various operations taught which will show how broad and effective the course is. This year a course for journeymen workers in the form of practical lessons will be inaugurated. Its success is problematical, but should it show any signs of growth and interest it may lead to future results which cannot fail to be of interest to the whole electrical fraternity.

(The lecture was accompanied by numerous lantern slides illustrative of the school.)

Igniting Bunsen Burners.

BY HENRY V. PARSELL, JR.

HERE is another Bunsen burner lighting rig which, though similar to that described by Mr. Cravath, differs from it in some details. Our laboratory, being in a private house, is provided with a battery and spark coil, of which one pole is



PARSELL'S METHOD OF IGNITING A BUNSEN BURNER.

connected to ground. The retort stand, a universal support, is grounded, so that on touching any part of it with a wire brush attached to the gas lighting wire the gas issuing from the burner

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may be ignited. Sometimes a burner is used with the paint cleaned from its base so as to connect in that manner.

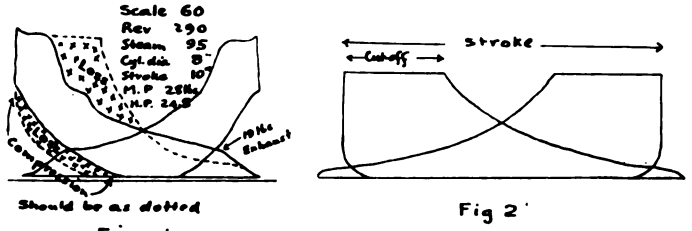
The only advantage claimed for this method is the absence of any danger of receiving as severe a shock as the breaking of an inductive resistance on a 110-volt cirucit must produce.

A Curious Engineering Criticism.

A FRIEND recently sent us the folowing interesting little story, which again demonstrates the old adage that "a little knowledge is a dangerous thing," and shows against what odds and ignorance engineers sometimes have to labor.

The indicator card shown in Fig. 1 was taken at the request of the owners of a hotel from an engine driving a 20 k. w. generator. Why they wanted it puzzled the consulting engineer, but he took it for them.

The reason appeared later. The manager of the hotel company wrote the engineer enclosing a criticism of the card by one of the directors, who evidently considered himself a "dab" at steam engineering. In his criticism he enclosed a cutting from a text-



A CURIOUS ENGINEERING CRITICISM.

book, Fig. 2, showing an "ideal card," with his own notes thereon and returning the actual card, Fig. 1, also with his remarks and the following gem of a critique: "Your cut-off is about ⅛ it should be ¼. Your exhaust is too early (due to high pressure), by which you lose 19 pounds of steam, unless part of it is used for heating; even then it is not the best economy. It should be about 6 pounds of steam lost at exhaust. Due to cut-off and exhaust, compression loses too much work. Revolutions should be about 320 per minute. Engines too large for work they are doing. Mean pressure is too high. Bring it down to 65 pounds; that will lengthen the cut-off and give more economical results, and a better card should be shown."

The drollest thing of all is that the manager of the hotel company, we have reason to believe, paid $25 for this effusion.

EDUCATIONAL

Massachusetts Institute of Technology.

A graduate's magazine, "The Technology Review," has just been issued by the recently organized Association of Class Secretaries. It is an octavo volume of 140 pages, attractive in appearance and of the best workmanship. The cover, designed by Hapgood and printed on Army brown paper, is very handsome.

The first number contains the Announcement; a photograph, with biographical sketch, of President Crafts; articles on "The Function of the Laboratory," by Professor Silas W. Holman, and on the "Pierce Building," by Professor Eleazer R. Homer, the architect; reprints in fac-simile of early Institute documents and letters, all in the first and more general half. The latter half, seventy pages, is given to news of the Institute, of the undergraduate and graduate classes.

Plans are shown of the several floors of the new Pierce Building, of the first floor of the Rogers Building as now altered, and of the Dynamo House. There are two half-tone inserts and two line drawings, one by Gelett Burgess. An excellent review of Professor Holman's recent book on "Matter, Energy, Force and Work," is given by Dr. Goodwin.

CITY ELECTRICIAN ELLICOTT, of Chicago, has revived the scheme to utilize the drainage canal for developing electric current for municipal plants.

PERSONAL

Mr. Henry G. Stott.

Mr. H. G. Stott.

MR. HENRY G. STOTT, the electrical engineer, Buffalo General Electric Company, whose interesting and important work we described last week, is a son of the late Rev. D. Stott, of Orkney, Scotland. He received his early education by private tuition from his father, then at the Watson College School of Edinburgh, and also in the public schools. He took the engineering course in the College of Science and Arts, Glasgow, now a part of the Glasgow and West of Scotland Technical College, and for three years gave especial attention to electrical engineering. Following this course of study, he was with a local central station company in Glasgow for a few months. Through the friendship that existed between Mr. Stott and Prof. A. Jamieson, of the above college, he was appointed assistant electrician of the Anglo-American Telegraph Company's cable ship "Minia," under the well-known Captain Samuel Trott. He remained with this company four and a half years, and then realizing that a much greater opportunity than he could hope for in the field of telegraph was opening in the lighting and power transmission fields, he resigned, and accepted a position with the Brush Electrical Engineering Company, of London, England. After a year with them, spent principally in their central station in Bournemouth, England, he left for Madrid, Spain, as one of the engineers for the contractors erecting a central station, engines, boilers, generators, underground cables and installation work. After this plant had been turned over to the Spanish company he returned to the Brush Company in London, Eng., and was engaged on underground cable work, etc. From London, Mr. Stott proceeded to New York, and was immediately engaged by Mr. C. R. Huntley, a shrewd judge of men, to put in the first underground cable used in Buffalo. The greatest testimony to Mr. Stott's ability as an electrical and mechanical engineer is found in the fact that while this engagement with Mr. Huntley was only for three months, he has been retained in his highly important position for seven years and three months. Mr. Stott's practical experience in electrical and mechanical work covers the years 1885 to 1898, not counting the three years' college training. His work in the plant of the Buffalo General Electric Co. is ample evidence of his skill in his profession and of his familiarity with the latest developments of its engineering. Mr. Stott is a member of the American Institute of Electrical Engineers.

Mr. Albert A. Cary.

Mr. Albert A. Cary has recently opened an office at No. 95 Liberty street, as consulting mechanical engineer, making a specialty of all branches of steam plant work and also developing testimony for lawyers and clients in legal proceedings. During his six or seven years with the Abendroth & Root Boiler Co., as engineering manager, he was constantly called upon to handle almost every problem connected with the use of steam, as well as the designing of steam plants in all their details, even to the complete power house; also the drawing of specifications and finally the testing of such plants to prove their fulfilment of guarantees, etc.

He has claimed, quite properly, that by feeding practically pure water to a boiler and by obtaining a perfect combustion of fuel in the furnace, the highest possible economy will result in the generation of steam. On these lines he has made an extended study of the purification of water for boiler (and other industrial) purposes, and his writings on this subject are doubtless familiar

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to many of our readers. His position in work of this kind is purely that of a consulting engineer, and in this he is associated with one of the best known firms of chemists in this country. He offers no special boiler compounds or apparatus to a client, but is very familiar with nearly all of these on the market, both in the United States and abroad.

In a new power plant, where there is more than one available source of water supply, he is prepared to make a careful determination of the best water to be used and will drive test wells, if needed, and report upon the advisability of this source of supply.

Mr. Cary has also designed and built a large variety of furnaces adapted to burn all kinds of fuel; his former connection with the steel business having made him thoroughly familiar with special furnace construction. He is also well acquainted with most of the special patent furnaces and stokers on the market, having made boiler tests with many of them in operation, including the use of all kinds of fuel in many sections of the country.

For general consulting he is associated with a number of leading specialists in the various branches of engineering work; with the object of giving clients the advantage of the best advice available in other fields as well as in his own.

After considerable experience with the engineering end of legal cases, Mr. Cary is prepared to serve lawyers and clients with such assistance as will relieve them of much of the care connected with the preparation and conduct of such cases. His methods are somewhat new in this work, but he looks for good results by applying engineering and commercial ability to obtain them.

Prof. Graham Bell Home from Japan.

Prof. Alexander Graham Bell, the world-renowned inventor of the Bell telephone and promoter of the "teaching of speech to the deaf," arrived here yesterday, says the San Francisco "Chronicle" of Dec. 28, on the steamship China with his wife and two daughters. He has been in the Orient for three months, during which time he traveled for several weeks in Japan. Prof. Bell is at the Palace, but will leave before the end of the week for his winter residence in the national capital, where he has a large scientific laboratory. Immediately upon his return to Washington he will read before the National Academy of Sciences a personal memoir dealing with his experiments and extensive observations in aerial navigation. He believes that airships will be successfully operated.

Another Fern from Szczepanik's Garden.

Szczepanik, the Polish schoolmaster who invented the fernschr, which enables one to see an object in its natural colors a great distance by means of an electrical device, announces that he has invented an apparatus operated by a beam of light, which he has applied to exploding bombshells.

Inquiry.

If W. J. C., of Buffalo, will send us his full name and address we will be glad to answer his inquiry.—Eds. E. E.

MR. W. O. KLEINE, city electrician, Cincinnati, O., proposes to use a portable electric light plant in the city sewers. Gasoline from dye factories percolates into the sewers and causes explosions owing to the present use of torches.

FRANK ADAM ELEC. CO. has been formed at St. Louis, Mo., with a capital stock of $25,000, to make electrical appliances, by F. Adam, F. B. Adam and L. M. Adam.

OBITUARY

MRS. BLOOMFIELD MOORE, the clever, eccentric and wealthy Philadelphian who backed Keely so strongly, has just died, from grief at his death and want of success, it is said. She believed in him to the last. A curious discovery has just been made of a large globe under Keely's workshop, with nipples and pipes leading to the laboratory. Various plausible excuses and reasons for its existence are offered.

NEWS & NOTES

The Siemens and Rotth Method for Cooling Dynamo-Electric Machines.

THIS method is embodied in a patent just issued to Georg Wilhelm von Siemens and August Wilhelm Hugo Rotth, of Berlin, Germany, bearing the U. S. patent number 616,979, and which they have assigned to the Siemens & Halske Electric Co., of America. The invention, which is described and illustrated below, relates to novel means for cooling dynamo-electric machines by effectively directing air against the heated surfaces of the dynamo for the purpose of reducing its temperature. The inventors have made careful investigations along this line and have found that in many types of dynamo-electric machines wherein ventilation has previously been employed, comparatively poor results have been attained even when securing the movement of large quantities of air through the ventilating-openings of the machines. Experiment has demonstrated that greater efficiency is secured by the movement of a comparatively small quantity of air past the heated parts, if properly directed against the same, than is attained by ordinary methods when very large quanties of air rush through the openings in the dynamo-electric machine. It is highly desirable that each of two requirements be met in order to secure the best results. First, the air must be conducted directly against the heated surfaces of the machine which are to be cooled, and arrangements preferably are provided whereby a comparatively large surface of metal may be exposed to the currents of air, and, secondly, the air-currents should be forced with great rapidity past the surfaces to be cooled, and by imparting to currents a whirling motion a very much greater amount of heat is taken up thereby, in view of the limited surfaces of the parts exposed, than is otherwise attainable. In this invention comparatively narrow air-channels are provided which limit the flow of air to a relatively small column, combined with means for securing a high velocity of the air moved past as great an area as possible of heat-radiating surface in the field-magnets and armature of a dynamo. The dynamo-electric machine used in describing the invention, contains a suction-fan mounted upon the shaft of the armature and rotating within a partially-closed chamber, which is adapted to draw air from the opposite side of the machine through comparatively narrow air-passages, which are constructed in whole or in part to secure a rotary movement of the air. Corrugated sheet metal is employed to increase the radiating-surface, if desired, and a diaphragm provided except at the central opening prevents the dispersion of air-currents flowing through the machine.

Having reference to the illustrations, Fig. 1 is a side view of the dynamo, partially broken away and in section. Fig. 2 is a vertical sectional view on line 2 2 of Fig. 1.

The machine is a four-pole dynamo having its right side developed to form a suction air-fan which is adapted to move the air rapidly through the dynamo from side to side in air-passages especially provided for it.

The circular frame *a* carries the four poles *b* of the dynamo, the armature *c* being rotatably mounted upon the shaft *c'*, rotating within laterally-extending arms *a'* of the frame. Upon the right side of the machine (see Fig. 2) are mounted the blades *d'* of the suction-fan *d*, which rotate in a partially closed chamber d^2. This chamber is formed by the outer diaphragm *e*, which is secured to the frame of the machine, and the inner diaphragm *f*, wherein is provided a circular opening *f'* approximately the size of the armature. Upon the right-hand side of the frame are provided the peripheral openings *e'*, which serve as discharge-outlets for the air. The field windings are provided with enclosing sheet-metal casings *g*, which extend from side to side upon the adjacent faces of the same and conform to the armature opening of the machine. Between the field-windings and the casings are provided corrugated sheet-metal strips *g'*, which engage the windings and increase their heat-radiating surface. The commutator of the machine and the armature are provided with lateral openings *h k*, through which the air readily passes from side to side. In the openings *k*, provided through the laminated core of the armature, are disposed the spiral metal strips *k'*, which impart to the air flowing through the openings a rotary

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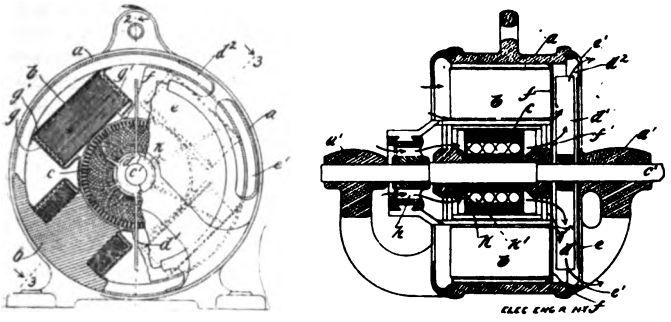
motion and direct the same intimately upon the exposed surfaces of the armature-core.

In Fig. 2 is illustrated by means of arrows, the flow of air-currents, which are forced through the machine with great rapidity from side to side when the dynamo is in operation. It will be seen that all parts of the machine that are liable to become heated have directed against them in the most efficient manner quantities of air proportionate to the velocity with which the armature rotates, and the field-magnets and the armature will accordingly be maintained comparatively cool by small quantities of air, which follow the conformation of these parts. The radiating-surfaces of any of the parts may be greatly increased, as indicated, by the use of thin sheets of corrugated metal disposed in contact



SIEMENS AND ROTTH METHOD FOR COOLING DYNAMO-ELECTRIC MACHINES.

with the parts, and the rotary or whirling movement which it is desirable to impart to the air is readily secured by the use of the metallic spirals *k'*. By employing the casings *g*, which conform to the exteriors of the fields and armature, narrow air-passages are provided which force the air into intimate contact with the respective parts, and, in connection with the diaphragm *f*, the movement of inefficient quantities of air between the widely-separated parts is prevented. The armature, which is particularly liable to heating, is provided with means for ventilating the same, since its core-openings constitute a central passage-way for the air drawn through the machine by means of the fan, and its periphery is likewise in constant engagement with rapidly-flowing currents of air, which take up the radiated heat.

It is sometimes found in the use of the invention that the air of the dynamo-room is not sufficiently cool to secure the best results, and the inventors have frequently found it desirable to take air for ventilating purposes from the exterior or a cooling-chamber in order to secure the necessary radiation of the heat from the dynamo. It is obvious that the air may either be forced or drawn through the machine, and the fan *d* may, if desired, be constructed to drive the air through the machine in the manner described instead of operating upon the principle of suction, as is set forth above. Highly satisfactory results may be obtained by connecting the ventilating-chamber *d* with the chimney of the power station, and in some instances sufficient draft may thus be obtained to secure the entire flow of air necessary for the purposes of cooling the dynamos.

Exports of Electrical Material from New York.

The following exports of electrical material were made from the port of New York for the week ending Jan. 3: Antwerp, 46 packages electrical material, $2,849. Brazil, 8 cases electrical material, $341. Cuba, 84 cases electrical material, $2,292. Copenhagen, 1 case electrical material, $36; 4 cases electrical machinery, $800. Ecuador, 10 packages electrical material, $76. Hamburg, 101 cases electrical material, $7, 359. Havre, 104 cases electrical material, $4,537; 13 cases electric motors, $1,300; 9 cases electrical machinery, $241. Hayti, 1 case electrical material, $45. London, 56 cases electrical material, $2,500; 1 case electros, $22. Liverpool, 41 packages electrical material, $1,726. Mexico, 27 cases electrical material, $705. Newfoundland, 1 package electrical material, $19. Newcastle, 12 cases electrical material, $1,000. Nova Scotia, 80 packages electrical material, $53. Peru, 5 cases electrical material, $77. Porto Rico, 3 packages electrical material, $22. Rotterdam, 1 case electrical material, $141. Rome, 1 case electrical material, $75. Southampton, 35 cases electrical machinery, $782; 37 cases electrical material, $1,424. U. S. Colombia, 4 cases electrical material, $120.

A Mammoth Power Plant for Everett, Wash.

A special dispatch from Everett, Wash., of Jan 8, says: J. D. Rockefeller's representatives are planning the erection of a mammoth electric plant to operate a railroad and factories there which Rockefeller controls. Among these are the Everett and Monte Cristo Railway, 65 miles long; mining machinery and concentrator at the Monte Cristo mines, a paper mill, nail works, a smelter, and a city lighting plant. Power for these is now produced by steam at large expense. It is found that by using electricity enough saving can be made to pay for the electric plant in three years. Engineers employed by Rockefeller's agents have made surveys along Stillaguamish River, finding a good dam site at Granite Falls. This dam will furnish water power generation for all the electric current required. It is believed that the Westinghouse system will be used similar to that which Chicago men are installing at Snoqualmie Falls.

The Everett and Monte Cristo Railroad has not been operated since it was partly washed out in Stillaguamish Canon, fourteen months ago. The destroyed portion has been located on higher ground, and arrangements made to rebuild.

This will cause the resumption of operations at the Monte Cristo mines, which were bonded to Rockefeller, who has just obtained absolute ownership. The line, together with the Everett industries named, will pay handsomely when operated by electric power.

A Sweeping Consolidation of Arc Carbon Interests.

A special dispatch from Chicago, of Jan. 9, says: Attorney Arthur J. Eddy has announced that a deal has been practically closed whereby the big carbon manufacturing concerns of the United States have been consolidated under the name of the National Carbon Co. New Jersey will be the legal home of the corporation, but its main offices will probably be situated in Chicago. The stock capitalization of the new company will be $10,000,000, as follows: Preferred stock, 7 per cent., non-cumulative, $4,500,000; common stock, $5,500,000; total, $10,000,000. The following are the names of the companies which will be included in the consolidation: The National Carbon Co., Cleveland, O.; Brush Carbon Works, Standard Carbon Works, Crouse & Tremaine Carbon Co., Fostoria, O.; Thomson-Houston Carbon Co., Fremont, O.; Faraday Carbon Co., Jeannette, Pa.; Phoenix Carbon Co., St. Louis; American Carbon Co., Neilsville, Ind.; Washington Carbon Co., Pittsburg, Pa.; Partridge Carbon Co., Sandusky, O.

These companies include a very large part of the carbon industry of the United States and three-quarters of the carbon industry of the world. In addition to the United States industries the company will own a half interest in the Ottawa Carbon Co. of Ottawa, Canada, which company controls, it is said, the carbon industry of Canada.

The new company assumes no debts or liabilities of any description. It purchases the various properties upon conservative appraisals free of all liabilities, and it will have in the treasury a working capital of $600,000. The following men will serve upon the Board of Directors of the permanent organization with two Directors yet to be named: W. H. Lawrence, president National Carbon Co., Cleveland; Myron T. Herrick, Cleveland; James Parmelee, president Cleveland Electric Illuminating Co.; James Humbird, president Washington Carbon Co., Pittsburg; E. D. Dickey, Jeannette, Pa., president of the Faraday Carbon Co.; Webb C. Hayes, Cleveland; J. C. Van Blarcom, St. Louis.

We are advised that the well known Solar Carbon & Mfg. Co., of Pittsburg, has not gone into the consolidation.

Northwestern Electrical Association.

As already announced in these columns, the Northwestern Electrical Association meets for its seventh annual convention on January 18, at the Hotel Pfister, Milwaukee, when a good attendance is expected. An excellent and varied programme of papers has been provided and was given in full in our issue of Dec. 29.

KITTANNING, PA. The contract for the building and equipment of the Kittanning & Ford City Street Railway Co., of which Mr. F. A. Moesta is president, has been given to the Altoona Electric Engineering & Supply Co., of Altoona, Pa. The road is five miles long, running from Kittanning north to Nealton and south to Ford City. It is to be completed and in operation before May 1.

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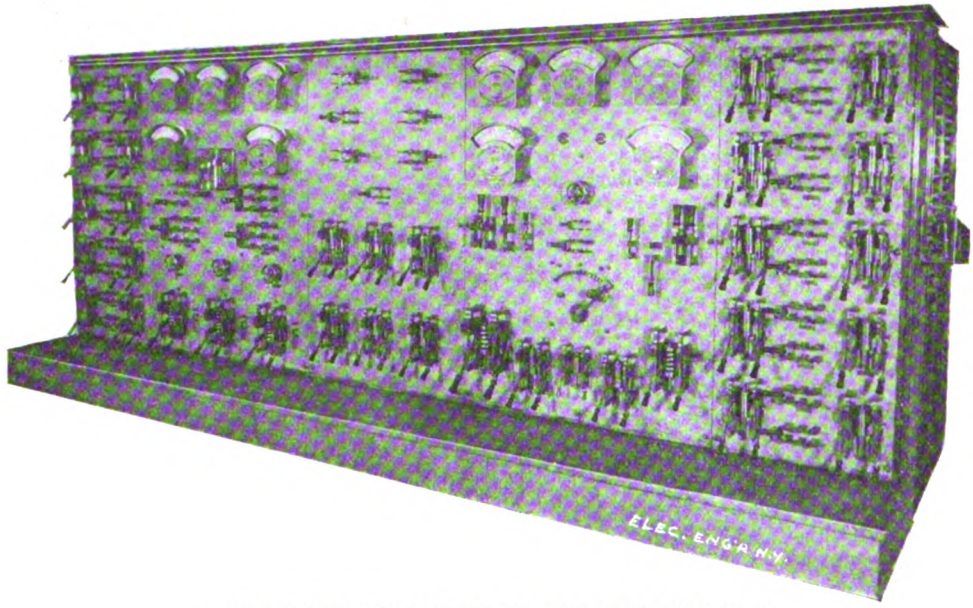
Switchboard for the R. G. Dun Building, New York City.

THE switchboard illustrated herewith was manufactured and installed by F. A. LaRoche & Co., 13th and Hudson streets, New York City. It is 20 feet long by 7 feet high, divided into 6 panels and raised on a marble step, as will be seen from the cut. The entire board is made of pink Tennessee marble, which is mounted on a substantial strong angle iron frame. On the front of the board are mounted 40 Ideal circuit breakers, and 32 of the La Roche self-locking hinge switches, nearly all of which are double throw.

The board is probably one of the most complete working boards in New York City. Each circuit leading from this board is protected with a switch and circuit breaker. The circuit breakers are of the well-known Ideal type, independent action, with vertical motion. On the same board there are 10 illuminated dial voltmeters and ammeters, which are also copper finish. All other metal work on the board is also highly polished and making a beautiful effect.

The back of this board is equipped with three sets of bus-bars, arranged with interlocking devices, and at the end of each board is an additional panel, as will be seen on the right hand side of the cut, on which are mounted Thomson wattmeters. Immediately back of this panel is another panel, which is used as an independent fuse board, the other end of the board being a duplicate. All fuses can be inserted with perfect ease, and without danger of short circuiting the system. The board is neatly capped off with a brass moulding, and the workmanship on the entire construction of this board is the best that can be done.



LA ROCHE SWITCHBOARD IN DUN BUILDING, N. Y.

Imports of India Rubber.

THAT the manufacturers of the United States and those depending upon them have been exceptionally busy in the year just ending is shown by some figures relating to the imports of manufacturers' materials and manufactured goods just compiled by the Treasury Bureau of Statistics. With large importations of manufacturers' materials and small importations of manufactured goods, and accompanying this an abnormally large demand at home for manufactures, it is apparent that those engaged in their production must have found constant occupation.

Four great classes of raw materials are habitually and necessarily brought into the country for manufacturers' use—raw silk, India rubber, fibers and hides. If the importations of these show a marked increase, it may be accepted as evidence of increased activity on the part of manufacturers. It is interesting, therefore, to compare the figures of the eleven months' importations in these great classes with those of earlier years. India rubber, of which large quantities are used by electrical and other manufacturers, shows in eleven months of the present year a value of $22,831,578, against $19,270,633 in eleven months of 1897; $12,964,633 in 1896, and $17,413,848 in 1895.

In all of the four great articles imported for the use of manufacturers, the importations of the year for the period covered by the above figures have been in excess of the preceding years, rubber being 50 per cent. larger than in 1894, silk 50 per cent. in excess of 1893, hides more than double that of 1896 or 1894, and fibers 50 per cent. in excess of 1894. When this increase in materials imported for the use of manufactures is considered in connection with the fact that the importations of manufactures have fallen in the year just ended from $283,000,000 in 1897 to $250,000,000 in the present year, it will be seen that there is good reason to believe that the manufacturers have been exceptionally busy. In addition to this, the figures of the Treasury Bureau of Statistics show that the exports of manufactures in the year just ended will reach in round terms an average of $1,000,000 a day for every business day of the year, and be in excess of any previous year.

The Technique of Speaking Tubes.

It has been ascertained that the greatest distance that a strong voice will carry distinctly through a straight tube without any branches, and in the absence of disturbing noises, is a little more than 450 meters. There is certain relation between the length of tube and its inside diameter, one of 30 millimeters being suitable for a simple tube up to 200 meters in length, but above this diameter must be increased to 52 millimeters. Tubes of much more than this in diameter or of less than 20 millimeters in diameter are not recommended, and the larger the diameter the stronger must be the voice and the clearer the articulation, words rich in vowels being transmitted more readily and long vowels being transmitted easier than short ones. Zinc is the best metal for the tube, owing to its slight elasticity, but for signals transmitted by knocks iron covered with zinc is preferable. A socket joint is best, because the elbow used in collar joints must necessarily project into the tubes, thus causing reverberation. The inside of the tubes should be as smooth as possible. Changes of diameter should be gradual, and sharp curves should be avoided. Tubes for speaking should bear upon masonry for diminishing vibration, while if they have to serve for transmitting knocks, they should be hung freely, and the latter method is better for signalling to a long distance, a whistle not carrying far.

BERNSTEIN ELEC. MFG. CO. has been formed under the laws of Maine with a capital stock of $100,000 by A. W. Putnam, Salem, Mass.; E. S. Gardner, Wollaston, Mass.; C. F. Langley, South Boston; J. T. Knapp, Roxbury, Mass.; and C. H. Tolman, Portland.

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"New Era" Gas and Gasoline Engines.

IN a recent issue we published a full description of a large central station in Paris, in which, due to small space which could be allotted to the machinery, gas engines had been installed as prime movers. The high efficiency and reliability of this installation and those of numerous others which have been built in this country and abroad have shown the gas engine to possess advantages distinctively its own, and which place it in the foremost rank of prime moving machinery.

One of the pioneer companies in this line of manufacture has been the New Era Iron Works Co., 54 Wayne avenue, Dayton, Ohio, whose gas engine, direct connected to a generator, we illustrate herewith. This engine has been built for several years, and is now running in many different sizes in many States, using all kinds of fuel.

It is of pleasing design, made heavy, strong, simple, and run at slow speed. Power is obtained by size and weight. It is built on the plan of a lateral shaft rotated by a spiral gear on the crank shaft, which in turn drives the governor by bevel gears, and operates directly on the valves by means of cams.

The absence of rods, elbows, arms, eccentric, cranks, etc., is emphasized, for on these sometimes hinge much trouble when adjustment is necessary from wear or otherwise. Often only an expert can get such parts in proper relation to each other.

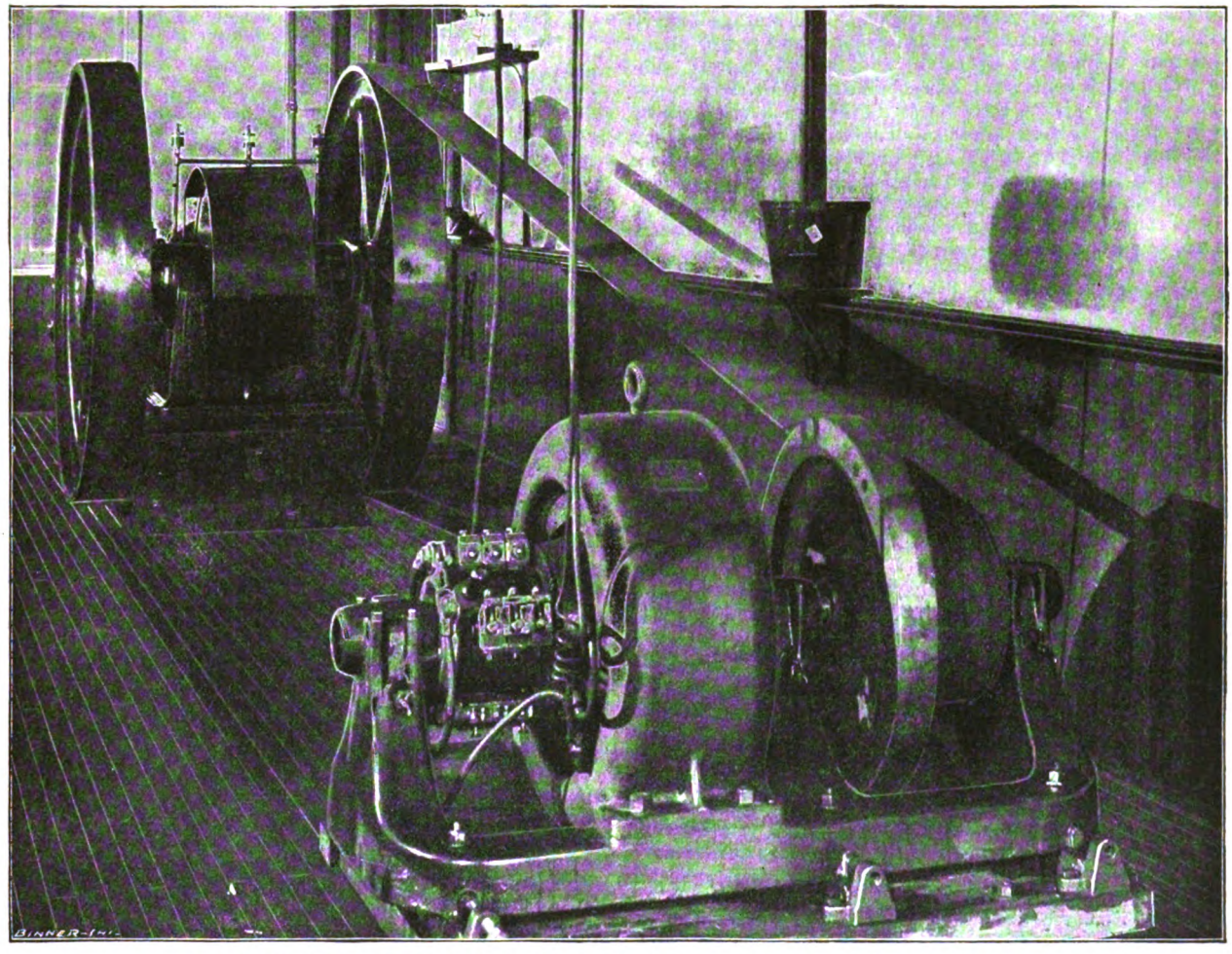
The valves are set so that they can be taken out, or ground in, by merely removing the nut that holds them in, without disturbing any other part. This must be done occasionally, hence this handy construction.

As both methods for exploding the gas, namely, by the electric spark or a hot tube, have their advantages, the company furnish either.

The battery outfit consists of proper cells for the fluid and of electrodes in the cylinder, with connecting wires. When the electrodes are clean and have proper contact, and the battery is of proper strength, a spark is created at the proper time that explodes the mixture in the cylinder. With the electric spark, the engine can be started in a moment, and the time of ignition made positive, thus producing the most satisfactory results.

The tube is simply a piece of gas pipe closed at one end with the other screwed into the cylinder. It is entirely enclosed by a chimney, and is heated by a Bunsen burner, the fuel being either gas or gasoline. The flame is small, not observed, and entirely safe. A few minutes' time must be taken to heat the tube, which the attendant can employ in oiling and cleaning up.

The governor is of the ball type, is extremely sensitive, and governs the fuel entirely when the speed gets above that at which the governor is set. This is called a self-scavenging method. Under less than full load, when the speed is too high, the fuel valve remains closed, and only pure air is sucked into the engine by the action of the piston, which, in due process, is emitted through the exhaust valve. This serves not only to clean the cylinder of burnt gas left from the previous explosion, but tends to cool the valve and cylinder. By an arrangement peculiar, it is said, to the New Era, the gas valve cannot remain open when the engine is at rest, and consequently there is no danger of flooding the engine room with gas.



35 H. P. NEW ERA SPECIAL GAS AND GASOLINE ENGINE IN AN ELECTRIC LIGHTING PLANT.

Though the cost to run a gas or gasoline engine cannot be given in figures, owing to the varying cost of fuel, the consumption of fuel can be stated.

According to the company's figures 17 to 20 cubic feet of natural gas per hour per horse power is required for engines of from 10 to 25 h. p. under full load, and 12 to 17 feet on larger sizes. Of coal gas somewhat more will be used. Producer gas requires still more, but it is very cheap. Of 74 gravity gasoline one pint per horse power per hour on engines of 10 h. p. and over.

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The consumption is based on a fully loaded engine; under less than full load a proportionate amount of fuel will be saved.

A very handsome catalogue issued by the company gives much interesting information about gas engines in general, and the "New Era" in particular. The company will be glad to answer inquiries and furnish information.

SOCIETY & CLUB NOTES

New York Electrical Society.

The 193d meeting of the Society will be held at the College of the City of New York, Lexington avenue and 23d street, on Thursday, January12, at 8 p. m., when Mr. Joseph Appleton will lecture on "Latest Progress in Storage Battery Installations." The lecture will be illustrated by slides, photographs and diagrams showing the most recent development in storage battery application to central lighting stations, railway and power plants with different methods of operation and control, battery substations with rotary converters, office buildings with electric elevators and isolated plants, etc. After the lecture a visit will be paid to the storage battery power sub-station of the Metropolitan Street Railway Company at the foot of West 23d street, where will be seen in operation a large railroad battery equipped with booster and all appurtenances. Attendants will be on hand to explain the construction, and give complete information concerning the use of this modern adjunct to railway power work.

National Electric Light Association.

Secretary George F. Porter writes as follows:—The twenty-second meeting of this association will be held in this city on the 23d, 24th and 25th of May next. Headquarters will be the Murray Hill Hotel, Fortieth street and Park avenue. Hotel rates will be: on the American plan, from $3.50 per day up, and on the European plan from $1.50 per day up, according to location of room.

The Electrical Exhibition Company will hold an exhibition in Madison Square Garden during the month of May, under the auspices of the Association and in connection with the meeting.

THE STOCK MARKET

A Year Well Begun.

The conditions for active business with which the year ended have naturally continued into the New Year, and bid fair to endure, as indicated by the fact that the total bank clearings on January 4 exceeded the single heaviest day ever reported before in New York. The state of trade is also very cheering, iron and steel being aggressively strong, exports large, and the spring openings favorable for unusually heavy demands. Railroad earnings continue to break records. Collections are reported good.

The stock market during the week was reactive, as might have been expected, but in spite of "profit taking" very considerably, on the rapid advances of the last sixty days, prices closed high and firm. For the short week the business was very heavy. No fewer than 59,540 shares of Western Union changed hands, rising to 96⅛ and closing at 95¼. General Electric, new, rose to 100½ on sales of 13,855 shares and closed at 99¼. New York Edison was dull and steady around 192. Metropolitan Street Railway was steady around 190. In Boston, Am. Bell Telephone sold off no fewer than 7 points, to 271, and West End Railroad was steady at 90½.

For the year, special note may be made of the high level attained by Chicago Edison. Its highest for 1897 was 140, while for 1898 it was 165. The bonds of the company showed proportionate advances, first 5's to 108, and deb. 6's to 103. In Philadelphia, Penn. Lt., Ht. and Power went from 18⅞ in 1897 to 25⅜ in 1898, and Electric Storage Battery Co. of Am. from 36⅜ to 67. These figures are similar to those from every great centre of the country.

INVENTORS' RECORD

Classified Digest of U. S. Electrical Patents Issued Dec. 27, 1898.

Alarms and Signals :—

RAILWAY SIGNALING DEVICE. Francis N. Myers, Windsor, Mo., assignor of one-half to Charles A. Draper, and Joseph S. Calfee, Windsor, Mo., 616,722. Filed April 2, 1898. Means whereby other engineers or other operatives of a train traveling upon a track may determine the positions and directions of movement of other trains upon the same track.

Conductors, Conduits and Insulators :—

ARMORED ELECTRIC CABLE. Edwin T. Greenfield, New York, N. Y., 616,612. Filed April 13, 1898. Consists of an insulated conductor having two or more metallic armor-strips spirally wound thereon and curved in opposite directions.

BINDING-POST FOR ELECTRICAL, TELEPHONIC, OR TELEGRAPHIC INSTRUMENTS. Joseph A. Williams, Cleveland, Ohio, assignor to the Williams Electric Company, Cleveland, Ohio, 616,755. Filed May 25, 1898. Comprises a plate, a saddle for the wire, a screw having a head overlapping the saddle, and a stop arranged to limit the inward movement of the screw.

Lamps and Appurtenances :—

SUPPORT AND TAKE-UP DEVICE FOR CABLE-SUSPENDED ELECTRIC LAMPS. John H. Dorion, Springfield, Mass., 616,607. Filed June 13, 1898. Constructive engagement about the shank of an electric lamp socket provided with two jaws, adapted when open to leave an unobstructed opening for the entrance of an object there between, jaw-operating members and jaw-closing springs.

ELECTRIC INCANDESCENT LAMP. Henry Francis Joel and Ferdinand Fanta, London, England, assignors to the Improved Electric Glow Lamp Company, Limited, London, England, 616,620. Filed July 29, 1896. A part of the bulb is either plated or otherwise provided with a coating for the purpose of transforming such coated part into a reflector.

ELECTRICAL SAFETY-LAMP FOR MINERS. Carl Francke, Berlin, Germany, 616,779. Filed April 18, 1898. Comprises a casing, a cap mounted to swing thereon and a switch located adjacent to the cap, the switch and cap having co-acting stop-lugs, by which to prevent the movement of the switch when the switch is in a certain position.

Measurements :—

RECORDING DEVICE FOR MEASURING INSTRUMENTS. Adrian H. Iloyt, Penacook, N. H., 616,669. Filed Aug. 13, 1897. Consists of a stylus moving over a renewable scale, back and forth in the same path, and tracing by such movement a line which, by its length, indicates the maximum reading of the instrument during a given time.

Miscellaneous :—

LIGHTING OR EXTINGUISHING AUTOMATICALLY INCANDESCENT ELECTRIC LAMPS. Charles S. Cole and John H. Kinsman, Bridgeport, Conn., 616,770. Filed April 1, 1898. Details of construction.

ELECTRIC HEATER. James F. McElroy, Albany, N. Y., assignor to the Consolidated Car-Heating Company, Albany, N. Y., 616,800. Filed Oct. 13, 1898. Consists of a supporting-helix and a resistance in the form of a compound helix arranged in continuous contact with each convolution of the supporting-helix in such a manner that the spaces between the convolutions of the supporting-helix shall register substantially with the spaces between corresponding convolutions of the resistance-helix.

Railways and Appliances :—

MECHANISM FOR STREET CARS. Fred S. Pearson, Boston, Mass., 616,595. Filed Sept. 14, 1897. Comprises an elevator situated within the car arranged to receive and hold the electric plow by which the car is propelled, and mechanism by which the elevator is raised from either end of the car, from the conduit into the car.

UNDERGROUND ELECTRIC RAILWAY SYSTEM. Frederick H. Chamberlain and Griffin B. Coleman, Washington, D. C., 616,824. Filed Dec. 2, 1897. Employs a plurality of interchangeable pairs of leads between the motor and supply-conductors connected to the current-collector, a switch for electrically connecting one or another of the pairs of leads with the supply-conductor, and electrical means for controlling the switch.

Regulators :—

ELECTRIC MOTOR AND METHOD OF CONTROLLING SAME. Charles W. Kennedy, Rutledge, Pa., assignor to Samuel Y. Heebner, Rutledge, Pa., 616,673. Filed April 22, 1898. Consists in starting the motor as a two-pole machine with a set of field-coils in series with each other, and subsequently changing it to a multipolar machine with all of the field-coils in parallel, and changing the internal resistance of the armature and maintaining the armature in balance uniformly around its axis.

Roentgen Rays :—

APPARATUS FOR MAKING OBSERVATIONS BY MEANS OF ROENTGEN OR X-RAYS. Jacques Wertheimer, Paris, France, 616,513. Filed Nov. 19, 1897. Details of construction.

Switches, Cut Outs, etc :—

INCANDESCENT-ELECTRIC LAMP SOCKET AND BASE. Christopher Van Deventer, New York, N. Y., 616,507. Filed April 1, 1898. Details of construction.

Telephones :—

AUTOMATIC TELEPHONE EXCHANGE. Frank A. Lundquist, John Erickson and Charles J. Erickson, Lindsberg, Kan., 616,714. Filed March 28, 1893. Details of construction.

TELEPHONE GRAVITY SWITCH. Charles Thomas Mason, Sumter, S. C., assignor to the Telephone Manufacturing Company, Sumter, S. C., 616,718. Filed May 3, 1898. A lever is provided with a forked end for sustaining the telephone receiver, the weight of which receiver is made by the act of hanging up or taking down the same to adjust the circuits through the agency of three-point contacts, so as to be either in position for receiving a call or for talking.

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Classified Digest of U. S. Electrical Patents Issued Jan. 3, 1899.

Alarms and Signals:—

ELECTRIC BLOCK SYSTEM FOR RAILWAYS. Hamilton Baluss, Jr., Wayne, Mich., 617,139. Filed Dec. 31, 1897. Especially designed for overhead electric railways or trolley lines, although the system may be applied to other kinds of railways.

FIRE DAMP DETECTOR. Gustav A. Lyncker, Munich, Germany, assignor to John Brandner, New York, N. Y., 617,111. Filed March 11, 1897. Actuated by the pressure of the fire damp, diffused through a diaphragm, lifting a stopper which closes the circuit.

ELECTRO-MECHANICAL GONG. Clarence E. Beach, Binghamton, N. Y., assignor to the Star Electric Co., New York, 616,879. Filed May 14, 1896. In which a normally restrained power may be released by the action of an electromagnet, and thus cause a body of suitable material to be projected against a bell.

Batteries Secondary: -

STORAGE BATTERY ELECTRODE. Theodore A. Willard, Cleveland, Ohio, assignor by direct and mesne assignments to Sipe & Sigler, Cleveland, Ohio, 617,004. Filed Jan. 26, 1897. A stiff electrode that cannot be buckled or warped out of shape by excessive charges and discharges.

TUBULAR ELECTRODE FOR STORAGE BATTERIES. Theodore A. Willard, Cleveland, Ohio, assignor by direct and mesne assignments to Sipe & Sigler, Cleveland, Ohio, 617,003. Filed Jan. 26, 1897. Tubular electrodes or elements for storage batteries of the type in which the active material is preferably converted or derived by electrical action directly from the surface of the electrode itself instead of having the active material applied mechanically or otherwise.

STORAGE BATTERY. Friedrich Wilhelm Schneider, Triberg, Germany, assignor to the Electricitäts-Gesellschaft Triberg, Germany, 616,978. Filed Dec. 3, 1896. An electrode for storage batteries, consisting in the special combination of elements.

MEANS FOR PRODUCING BATTERY ELECTRODES. Theodore A. Willard, Norwalk, Ohio, assignor by direct and mesne assignments to Sipe & Sigler, Cleveland, Ohio, 617,002. Filed May 4, 1896. A cutter for producing leafed battery plates having a cutting edge inclined downward from front to rear and a bearing surface on its bottom inclined laterally and an inclined top surface.

Conductors, Conduits and Insulators:—

PILOT WIRE ROD FOR ELECTRICAL CONDUITS. James Arnot, Kearny, N. J., 617,216. Filed May 24, 1898. An improved apparatus for inserting pilot wires through the conduits.

NAIL, HOOK OR STAPLE. Heinrich Traun, Hamburg, Germany, 617,064. Filed Dec. 3, 1897. A nail, hook, staple or the like made of vulcanite.

INSULATING ARM. John D. Taliaferro, Loudon, Tenn., 617,062, June 18, 1898. An arm which will not only be equipped with wire-holding insulators at suitable distances apart, but will also provide for insulation in the event of the wires becoming displaced from such insulation.

DOWEL FOR CONDUIT PIPES. Scudder Carroll, St. Louis, Mo., assignor of one-half to the Abbot-Gamble Contracting Co., St. Louis, Mo., 616,895. Filed Oct. 8, 1898. A conduit formed with continuous dowel openings to co-operate with a dowel at any point where the conduit may be broken and a dowel formed of a rod comprising its body portion, the rod having a fin or bur struck up from its side to limit the inward movement of dowel in the dowel opening.

ELECTRIC CONDUCTOR SUPPORT. Johan M. Andersen, Boston, Mass., assignor of one-half to Albert Anderson, Boston, Mass., 616,872. Filed Feb. 8, 1898. An insulating plate provided with a circular slot, a plurality of conducting arms extended from the plate and provided with projections to engage the slot, and means to secure the arms to the plate.

Distribution:—

SYSTEM OF ELECTRICAL DISTRIBUTION. Samuel Kirlin, Watertown, S. D., 617,165. Filed Aug. 18, 1898. Consists of a primary circuit, a secondary circuit, two or more transformers common to both circuits, a device in the primary circuit, mechanically responding to current changes therein, an electromagnetic switching device automatically controlled by the responsive device, adapted to switch the said transformers in and out of the primary and secondary circuits.

Dynamos and Motors: -

MEANS FOR COOLING DYNAMO-ELECTRIC MACHINES. Georg Wilhelm von Siemens and August Wilhelm Hugo Rotth, Berlin, Germany, assignors to the Siemens & Halske Electric Co. of America, Chicago, Ill., 616,979. Filed Oct. 22, 1898. Described on page 68.

ELECTRIC MOTOR. Charles R. Meston, St. Louis, Mo., assignor to the Emerson Electric Mfg. Co., St. Louis, Mo., 617,114. Filed July 9, 1898. An induction motor for ceiling suspension having the fan blades mounted directly upon the armature.

Electro-Metallurgy: -

ELECTROLYTIC REDUCING AND AMALGAMATING SLUICE. Joseph H. Jory, San Francisco, Cal., 617,024. Filed May 27, 1897. Means for extracting gold, silver and other metals from slimes and solutions.

ELECTROLYTIC APPARATUS FOR TREATING METALS AND ORES. George D. Burton, Boston, Mass., 616,891. Filed July 19, 1897. Particularly adapted to separate metals from their ores, but may be applied to other purposes, such as separating copper or other metallic substances from sand or from such substances as contain metallic particles which are either mechanically or chemically combined.

Measurements:—

TRAVELING TEST APPARATUS. Edgar Speiden, Jr., Washington, D. C., 616,983. Filed Dec. 6, 1897. A testing apparatus which is adapted to travel with relation to the terminals of electric circuits, to receive current when so traveling, and to carry testing devices whereby the circuits can be readily tested.

Miscellaneous:—

ELECTRIC PROPULSION OF VEHICLES. Friedrich Wilhelm Schneider, Triberg, Germany, assignor to the Electricitäts-Gesellschaft, Triberg, Germany, 617,102. Filed Dec. 10, 1897. The working of vehicles with accumulator propulsion, in which the main battery, when starting, is put in circuit parallel with a small auxiliary battery constructed for quick discharge, for the purpose of supplying the additional current required, at the start, from the auxiliary battery and thus avoiding a high rate of discharge from the main battery and augmenting its efficiency.

MEANS FOR GENERATING ELECTRICITY FROM MACHINERY OF LOCOMOTIVES. Harry F. Roach, St. Louis, Mo., 617,187. Filed Oct. 10, 1898. The combination of a dynamo mounted upon the frame of a locomotive, cranks or eccentrics mounted on the armature shaft of the dynamo and arranged at an angle with relation to each other, converting the reciprocatory motion of the cross-head into rotary motion of the armature shaft.

ELECTRIC ELEVATOR. Alonzo B. See, Nils O. Lindstrom and Dan'l A. Mason, New York, N. Y., 617,128. Filed April 20, 1898. May be controlled without the assistance of other attendant than the passenger who desires to be transferred from floor to floor.

APPARATUS FOR ELECTRIC CURRENT SUPPLY, ETC. Edwin James Preston and Arthur Bernard Gill, London, England, 617,121. Filed Dec. 29, 1897. Relates more particularly to the lighting and heating of railway cars by a dynamo which is driven from the car axle, preferably by an equalizing frictional driving mechanism.

ELECTRO-MAGNETIC APPARATUS FOR ACTUATING MECHANISM. Samuel Hamilton Hoggson, Chicago, Ill., 617,099. Filed Aug. 4, 1897. Details of construction.

HELIX FOR ELECTRICAL APPARATUS. John T. Williams, New York, N. Y., 617,067. Filed April 3, 1895. Means for overcoming, diverting or suppressing self-induction in electro-magnetic apparatus, the object being to reduce or prevent the retarding or impeding effect which self-induction creates in all forms of electro-magnetic apparatus wherein alternating, pulsating, intermittent or other irregular currents flow.

ELECTRIC BUOY. Ernst Wilhelm Gustav Hoffman, Charlottenburg, Germany, assignor to the Siemens & Halske Electric Co. of America, Chicago, Ill., reissued patent, 11,706. Filed Dec. 8, 1898. A hollow cylindrical buoy, within which are provided a pump and electric motor, whereby water is pumped in and out of the said buoy, thereby sinking or floating the same.

METHOD OF REFINING VEGETABLE FIBER. Hertrand S. Summers, Chicago, Ill., assignor of one-half to Charles O. Boring, Chicago, Ill., 616,988. Filed Dec. 9, 1896. An improved method of refining ramie and other vegetable fibers.

ELECTRIC FURNACE. James A. Deuther, Boston, Mass., 616,906. Filed June 2, 1897. An electric arc furnace, two opposite electrodes, a mechanism for moving one of the electrodes relatively to the other, a feed mechanism, a regulator operating independently of the feed mechanism and located adjacent to the anode for receiving the material to be treated from the feed mechanism and for supplying the same to the arc, and means for operating the regulator.

Railways and Appliances:—

ELECTRO-MAGNETIC BRAKE. Frank C. Newell, Chicago, Ill., 616,956. Filed Feb. 5, 1898. Involves the use of the track brake, the contact being applied through the medium of a suitably arranged electromagnet.

TIMING APPARATUS FOR TROLLEY RAILWAY SYSTEMS. Henry Garrett, Dallas, Texas, 617,010. Filed April 19, 1898. An ordinary time mechanism in combination with a continuously active oscillatory, indicating pointer having an operative connection with the time mechanism and further details of construction.

Switches, Cut-Outs etc,:—

COMBINED LIGHTNING ARRESTER AND FUSIBLE CUT-OUT. Burton L. Lawton and Ernest C. Wilcox, Meriden, Conn., 617,170. Filed Aug. 2, 1898. A combined lightning arrester and fusible cut-out for electrical circuits effective in operation and simple, strong and durable in construction.

ELECTRIC SWITCH. Oscar H. Schuck, Philadelphia, Pa., 617,193. Filed July 2, 1898. A switch that should it be opened will be automatically closed upon the closing of a door, and cannot be opened and left opened when the door is closed.

QUICK-BREAK ELECTRIC SWITCH. William F. Bossert, and Geo. L. Holton, Utica, N. Y., assignors to the Bossert Electric Construction Co., New York, 617,275. Filed June 9, 1898. Reducing sparking to a minimum, increasing the conductivity and insuring a quick break upon throwing the switch to interrupt the circuit in which it is located.

CIRCUIT CLOSER. Judson D. Garlock, Palmyra, N. Y., assignor of one-half to the Garlock Packing Co., New York, 617,287. Filed April 22, 1898. The novelty resides in the peculiar construction and the combinations and arrangement of parts.

Telephones:—

TELEPHONE EXCHANGE SWITCH AND SIGNAL APPARATUS. William W. Dean, Boston, Mass., assignor to the American Bell Telephone Co., Boston, Mass., 617,145. Filed March 19, 1898. Relates to the central office apparatus of a telephone exchange, and particularly to the switchboard connecting devices, the section of the conversation circuit of the same, and the signal receiving and controlling devices connected therewith.

TELEPHONE RECEIVER. Jas. J. Mulconroy, Philadelphia, Pa., 616,953. Filed May 7, 1898. A cushion for a telephone receiver, composed of yielding material, and constructed as an annular body of approximately semi-cylindric transverse section, the outer edge of which is adapted to grasp the rim of a receiver, the inner edge of which is adapted to rest freely or unsecured against the end face of a receiver, forming an air cushion between its inner and outer edges.

Roebling Construction Co.

Articles of incorporation of the Roebling Construction Co. have been filed with the Secretary of State of New Jersey. The company starts with a capital stock of $250.000. Of the 500 shares of the company, Frank H. Croker, son of Richard Croker of New York, has 170, Frederick Roebling 260, James W. Hinkley of Poughkeepsie 50, Charles G. Roebling 10, and Frank O. Briggs 10. The new concern will engage in the manufacture of iron for fireproof buildings in all parts of the world, and intends, according to the articles of incorporation, to erect buildings in Massachusetts, Rhode Island, Connecticut, New York, and Illinois. The Roeblings, who are the largest shareholders, are members of the firm of John A. Roebling's Sons.

AUTO-TRUCKS. The American Wheelock Engine Co., of Worcester, Mass., states that it has an order, through Mr. J. H. Hoadley, for 250 compressed air auto-trucks.

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TRADE NOTES AND NOVELTIES

Hardware and Electrical Supplies.[1]

BY A. HARDWAREMAN.

THE writer was for many years engaged in the jobbing hardware business as traveling salesman, and later as manager of an important department of a large jobbing house. Some time ago he engaged in the manufacture of electrical machinery, but, as an old hardwareman, all matters pertaining to the welfare of the hardware fraternity are deeply interesting. Since entering the electrical field he has been impressed with the unsatisfactory manner in which the electrical trade of the country is conducted in all places outside of the large cities. In the large cities (over 100,000 inhabitants) the electrical trade reaches a volume sufficient to support dealers handling nothing but electrical supplies, but the many smaller cities and towns with electric light plants cannot support separate dealers in this line. The consequence of this is that the electrical business is largely undeveloped outside of the large cities, for the reason that no one capable of handling the trade is at all interested in the matter.

The average electrical dealer in smaller places is either a young fellow fresh from school or college, who has picked up a smattering of electrical knowledge, and who, by reason of this, is looked upon by his associates as a budding genius, but who is absolutely destitute of business training or financial responsibility; or he is an electrical workman who has accumulated a little money, and is equally without real business experience. It is, of course, impossible for such persons to handle any business with the greatest amount of success to themselves or satisfaction to their customers. Instead of being surprised that so many such people fail, the real wonder is that so many succeed; and the fact that many do succeed proves that the supply business has great possibilities for any man of business experience and sagacity who gives it the proper attention.

In many instances the electrical trade is handled by the electric light stations, but as they are interested only in such supplies as conduce to the extension of their own business, they develop the trade only to a very limited extent. An electric light station is not fitted for carrying on a trading business, and most of them would be only too glad to turn this business over to any dealer capable of taking care of it, and in addition would give this dealer all assistance and information in their power. Having outlined the present status of the electrical trade, the question naturally arises: What has all this to do with hardware? It has everything to do with it, as the electrical supply business should by every logical reason, be a branch of the hardware business.

The successful hardware retailer must be a man of more than average intelligence and business ability, as he handles the most complicated and varied line of merchandise extant. He is familiar with machinery, and usually runs a tin shop or bicycle repair shop in connection with his store. While the admission must be made that in manufacturing electrical apparatus a great deal of special technical knowledge is necessary, the selling of electrical supplies does not call for any more knowledge than any other line of merchandise, and is, in reality, not nearly so complicated as many lines familiar to every hardware dealer.

The way to start a successful business in this line is to employ some young man with a little electrical knowledge, let him attend to the electrical questions, having him under strict supervision to see that the business is handled on conservative lines. A good start can be made with a very small outlay—a few lamps of the style used by your electric light station, some lamp cord, sockets, switches, a few electric bells, batteries, etc., buying everything in small quantities and expanding the line as the growing business demands. The retail profit on almost all items is large, and in many other ways the electrical line works in well. In the fall and winter months the sale of incandescent lamps is large, and as these are continually being broken or burning out, this fact assures a steady business.

In the spring and summer months a large business can be worked up in fan motors, this line running rapidly into money with good profits at a time of year when the general hardware trade is dull. The hardwareman who has a bicycle repair shop is particularly fitted for electric wiring and simple repairing, as most of the troubles in common electrical apparatus are readily located and repaired by any one with ordinary mechanical ability. Most of these defects show up in the fall when people begin using lights extensively, and the busy season in electrical wiring and repairing is just when the bicycle repair man is enjoying a period of leisure.

Most people look upon the electrical business as a matter entirely beyond them, but there is absolutely no reason for such a belief. There are probably a dozen good hardware firms known to the writer who have taken up the electrical supply business in the last year, and they have, without exception, been successful, and have largely increased the electrical business in their locality. It would not have been possible five years ago, or even two years ago, for the hardwareman to enter on this line, as the manufacture of electrical appliances was largely in the experimental stage. The past two years, however, has practically standardized this line, experience and use have sifted the good from the bad, and there is no more danger of change in this line than in any other line familiar to the hardware dealer.

The National Board of Fire Underwriters issue free to any applicant a book called "National Electrical Code," giving the approved practice in all electrical matters. This, in connection with their "List of Electrical Fttings," will prove a sure guide to the buyer until he can rely upon his own judgment. The difficulty the retail buyer will first experience is to find out where he can buy these various articles to best advantage, and this brings up the point that the present electrical supply jobber must change his methods of doing business in some ways if he is to hold the trade when it drifts to the hardware dealer, as it undoubtedly will in time.

The electrical supply jobber cannot cover any given territory as often or as thoroughly as is desirable, owing to the fact that the entire selling expense falls upon one line of merchandise. For the next few years it will probably be the larger hardware dealers who will develop the necessary energy and enterprise to embark in this field, and by that time the electrical supply houses may have grown to a degree enabling them to cover the country approximately as frequently and thoroughly as it is now covered by the hardware jobber.

That the addition of electrical supplies by the retail hardwareman would largely increase his sales and provide him with a new line of profitable merchandise at a time when the prices and profits of hardware are lower than ever before known is an indisputable fact. The handling of this line by the hardware retailer will place the electrical supply business in the hands of experienced business men, who are fully capable of taking care of the consumer, and who will at the same time command the confidence of the electrical jobber and manufacturer.

This is a condition that is longed for by all electrical jobbers and manufacturers, and would result in a development and expansion of the use of electrical supplies in the smaller cities and towns that is at present but dimly realized. It is impossible, at present, to foretell the exact manner through which the retail hardwareman will procure his needs in this line, but, as in all other lines, we may rest assured that the trade will follow the path of least resistance, and the sources from which the retailer can obtain the most prompt and satisfactory service will obtain the lion's share of the trade.

That there is certain to be some decided change in the method of handling this line of merchandise is obvious to any thinking man who is familiar with the situation. There is a growing feeling of unrest and dissatisfaction with prevailing methods that evidences itself most strongly in certain sections and under special conditions, and this will continue growing in strength until the natural and proper solution of the problem is gradually worked out. The developments to this end are being closely watched by the more progressive firms interested in either of these important classes of trade, and the writer hopes that this article will be the means of bringing the matter to the attention of a large number of hardwaremen, so that they may share, according to their opportunities and ability, in reaping the benefit from a line of trade that is adapted to their present business, and the opportunities of which are practically undeveloped and unlimited.

[1] Iron Age.

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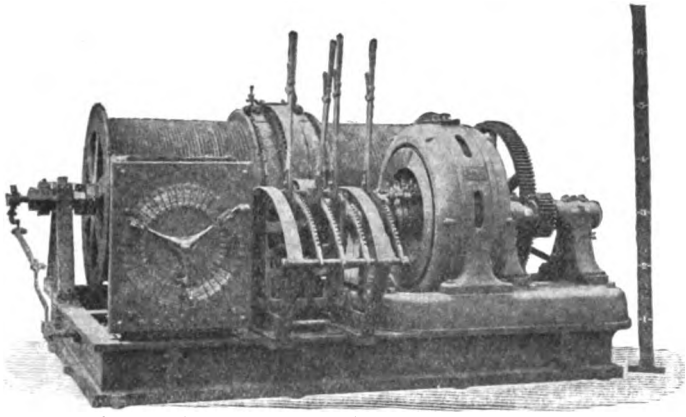
G. E. Double Drum Hoist and Electric Motor.

THE electric hoist illustrated shows one of the recent applications of a General Electric induction motor to a double independent drum Lidgerwood mine hoist. It is compact in form, and the levers controlling the clutches and brakes and handle of rheostat are placed in the position most convenient for control by the operator standing on a platform above the floor and having a clear view over the top of the hoist.

Each friction drum is driven through a single reduction gear-



G. E. ELECTRIC DOUBLE DRUM HOIST.

ing by a 100-volt 12-pole induction motor of 30 h. p. capacity running at 600 r. p. m. Each drum is independent, and is 42 inches in diameter by 40 inches face. Together they hold about 420 feet of ⅞-inch rope. The maximum hoisting speed is 300 feet per minute, and the weight hoisted, i. e., load car and cage, 2,100 pounds. The depth from which the load is to be hoisted is 400 feet from the surface.

Emerson Church Organ Motors.

The Emerson Electric Mfg. Co., of St. Louis, Mo., has recently perfected a device by means of which church organs can be operated with alternating current motors, and request correspondence from all parties interested in this class of apparatus. This device has been perfected in response to inquiries covering a number of years, and is now placed on the market by the Emerson Company, as they believe it is a thoroughly practicable and efficient device. An illustrated descriptive article of this device will appear shortly, and in the meantime the manufacturers would be pleased to send descriptive circular and prices to the electrical fraternity upon request. In corresponding about this matter, ask for circular No. 2,001.

Commercial Dynamos in Japan.

The Commercial Electric Co., Indianapolis, Ind., has recently installed a complete lighting and power plant for the Omi Mashi Boeski Kwaisha, Kioto, Japan, which is a large flax spinning mill. All the machinery and supplies furnished were of American manufacture, and installed through the Commercial Co.'s agent, Paul G. Fiedler, Yokohama, Japan. This is the fourth plant installed for the Commercial Company in Japan by Mr. Fiedler within the last few months.

C. & C. Iron Clad Dynamos and Motor.

Bulletin No. 127 superseding Nos. 112, 116, 122, and 125, has recently been issued by the C & C Electric Company, 143 Liberty street, New York, N. Y. A number of the various types shown have been illustrated in our pages from time to time, but the catalogue contains so many new illustrations and the descriptions show so many novel types that any one interested in electric motors and their applications would do well to send for one of these new catalogues. The closed and open types, front and back geared, are fully described, as is also the electric hoist and coal cutter, and various types of generating sets consisting of C. & C. dynamos and Forbes and Case engines. There are also chapters on the C & C "Reaction" brush holder, automatic starting boxes and field regulator. The catalogue will be sent to any one on application.

Peckham Trucks for the Third Avenue Road, N. Y.

Once more the Peckham Truck Co., of the Havemeyer Building, New York, has secured a big order for its trucks, and this time on "its native heath," if the expression is allowable, when heath and horses alike have become negligible quantities in the street railway art. Mr. Edgar Peckham has just signed with the Third Avenue Railroad for its new work a contract to furnish 100 pairs of 14 B short wheel base "swing bolster" trucks, and 60 pairs 14 D2 "maximum traction" trucks. As is well known, the Third Avenue Company is equipping with electricity, and is making a very careful selection of apparatus.

NEW YORK NOTES.

THE "RIVERSIDE" TELEPHONE EXCHANGE has been opened by the New York (Bell) Telephone Co. to handle its business in the territory bounded by Seventy-second and One Hundred and Tenth streets, Central Park and the Hudson River. It has the new lamp signaling system on the board.

NEWARK, N. J. The Peoples Light & Power Co., whose very extensive system was described in The Electrical Engineer last week, has decided to increase its capital from $5,000,000 to $20,000,000, in view of the absorption of the Hoboken and Elizabeth local lighting companies.

AMERICAN ENGINE CO. This enterprising concern of Bound Brook, N. J., has found it necessary to open a New York office to take care of its growing business in this territory in engines, dynamos, motors, etc. It has secured quarters at 95 Liberty street, and has put in charge Mr. Edwin S. Boyer, formerly of Philadelphia, who will be glad to give prompt attention to inquiries, etc.

OKONITE CO., 253 Broadway, New York, have favored us with their very dainty and decorative calendar for 1899, with a central Watteau figure, and the trade-mark modestly peeping over one corner of the back card.

BUFFALO, N. Y. The Buffalo General Electric Co. is successfully exchanging and refunding $2,100,000 of its 6 per cent. bonds into a like amount of 5 per cent. 40-years. The saving of $21,000 becomes available for the stock which made a prompt advance of 10 points when the news came out.

WESTERN NOTES

WALKER CO.'S BONDS. In pursuance of an agreement between the Westinghouse Electric Company and the Walker Company the issue of $2,500,000 of first mortgage bonds of the last-named company has been divided into two classes. All of the bonds were purchased by the Westinghouse Company, and the directors of that company agreed to make $1,650,000 of them a second mortgage. The necessary legal steps have just been taken in Cleveland to have the mortgages on the Walker plant properly classed. There is now a first mortgage of $850,000 and a second mortgage of $650,000, the bonds issued under the latter still being in the hands of the Westinghouse Company.

GOULD ELEC. PROTECTIVE CO. has been formed in St. Louis, for a general alarm and signal business by H. V. P. Cooke, A. T. West, O. H. Vieths, W. F. Noeker, J. T. Drummond and A. B. Gould.

THE ELECTRIC APPLIANCE CO. have ready for distribution a complete catalogue of the celebrated Whitney electrical instruments. The Whitney instruments are too well known to require any particular comment, and this catalogue should be in the hands of every buyer of test instruments.

THE AUTOMATIC SWITCHBOARD CO. has been formed, with headquarters at Dayton, O., to make and sell automatic telephone switchboards. The authorized capital stock is $10 000, and the incorporators are W. M. Bell, C. Whitney, W. M. Weakley, W. L. Blocher and L. C. Walker.

MR. H. W. WISWELL, electrical engineer, formerly with the General Electric Co., and who has been for the past year associated with the New York & Ohio Co. as manager of their

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transformer department, and who designed their model '98 transformer, makes the announcement that he has resigned his position with that company, his contract having expired, and has associated himself in a similar capacity with the Warren Electric & Specialty Co., Warren, O. This company will place upon the market their New "Peerless" transformers, and expect to be able to make deliveries about April 1, 1899.

THE VICTOR TELEPHONE MFG. CO. have just secured the order for the entire equipment of the Chequamegon Telephone Co.'s new exchange at Ashland, Wis., consisting of a 400-drop board, 300 telephones, cross-connecting boards, etc.

CAPT. G. N. STONE, of the Cincinnati Bell Telephone Exchange has given the girls in the various centrals the usual 8 per cent. of their annual salaries, as a Christmas present.

ELECTRIC APPLIANCE CO. Owing to the enormous pressure of general business, the Electric Appliance Co., of Chicago, will not move their new quarters until about Feb. 15.

GRAND TRUNK TELEGRAPHERS, recently disgruntled, have submitted their grievances to arbitration, choosing Mr. F. L. Sargent, and the railroad company choosing Mr. B. B. Osler, Q. C., of Toronto.

THREE RIVERS, MICH. The city officials, after making diligent inquiry as to the profits in municipal electric light plants, have abandoned the idea of operating one of their own.

NEW ENGLAND NOTES

GROTON, CONN. The Groton Electric Co. has formed with a capital stock of $10,000. Mr. H. L. Bailey is president, Mr. R. H. Burrows secretary, and Mr. J. A. Morgan treasurer. The company says it does not expect to begin operations for the present.

LOWELL, MASS. The new church known as the Pawtucketville Church, at Lowell, Mass., is being erected in accordance with plans made by Architect J. Merrill Brown, of Boston. The church will be built on modern lines. Over the interior auditorium will be placed heavy steel trusses having a clear span supporting the roof framing and ceiling. J. H. Connell & Co., Lowell, are the general contractors for the work, and the Berlin Iron Bridge Co., of East Berlin, Conn., furnish and erect the steel work.

B. F. STURTEVANT CO., of Boston, Mass., in its recently issued Bulletin G, illustrates and describes a unique generating set, in which both the engine and the generator are entirely enclosed, although perfectly accessible through suitable doors. Such a device is of manifest utility wherever the atmosphere is laden with dust. This bulletin, containing other information of interest, will be mailed on application.

CALENDARS have been received from the Phillips Insulated Wire Co., Pawtucket, R. I.; Smith & Thomson, manufacturing stationers, and others, all being welcome pieces of office equipment.

MR. STUART W. WISE, who was formerly treasurer of the Manhattan General Construction Co., has opened an office in the John Hancock Building, 178 Devonshire street, Boston, Mass., the former New England address of the Manhattan Co. Mr. Wise will push the sale of the Manhattan enclosed arc lamps from the above address. The company manufactures lamps for direct current circuits to operate singly on 110 to 220 volts; two or more series on 220 to 550 volts, and to operate singly or in series on alternating current circuits.

PHILADELPHIA NOTES

BRADFORD, PA. The Bradford Electric Light & Power Co. reports that it is now supplying 5,000 incandescents and 200 arcs. It has converters of 6,000 light capacity, and 20 miles of circuit. The apparatus is Westinghouse and Thomson-Houston. There are two 125 h. p. Taylor-Beck engines, one 125 h. p. Ball, one 200 h. p. Ball and six Erie 100 h. p. boilers. G. H. Potter is president, D. W. Robertson vice-president, F. Hamilton treasurer, and J. H. Rose secretary and manager.

THE BALL ENGINE CO., Erie, Pa., will furnish the engine to be used in the electric light plant being erected by the Seckner Contracting Co. at Churubusco, Ind.

SOUTHERN NOTES

SMITHFIELD, VA. The Citizens Electric Light & Water Co., formed recently, has an authorized capital stock of from $3,000 to $20,000, and has organized with Mr. J. L. Cowling as president. The company is now in the market for engine, boiler, etc.

HINTON, W. VA. The Hinton & Southeastern Telephone Co., formed in November with a capital stock of $50,000, has organized with A. J. Skaggs as president, A. E. Miller vice-president, J. H. Miller attorney, and C. L. Miller secretary and treasurer. There are 24 miles of circuit and 28 subscribers. The lines are expected to be complete by Jan. 15.

THE CROCKER-WHEELER ELECTRIC CO., 39 Cortlandt street, New York, illustrate their advertisement with a cut of one of their size 2 motors, geared to vertical boring mill; the changes in speed are effected by a nest of gears.

CONTENTS.

Department News Items will be found in advertising pages

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The Electrical Engineer.

Vol. XXVII. JANUARY 19, 1899. No. 559.

A New Process of Printing by the Use of X-Rays. Typo-Radiography Faster Than Any Conceivable Method Now Used.

BY DR. FREDERICK STRANGE KOLLE.

PRINTING by the use of the X-rays was perhaps first suggested by Prof. Elihu Thomson in an article appearing in The Electrical Engineer of March 11, 1896, wherein he showed that multiple radiographs could be made at one exposure; these he called mutiple skiagraphs.

The experiment proved that more than a single sheet of sensitized paper would be affected by the rays when laid one upon the other, setting aside the theory that the chemical composition of one sensitized film would absorb most of the rays. For the experiment he used an iron key escutcheon and a number of kinds of printing celerite and bromide papers and, lastly, an ordinary dry plate.

Owing to the thin sensitized films of the printing papers, very unsatisfactory skiagraphs were obtained—the bromide paper giving better results while the photographic plate, although farthest from the object, contained the best image. From this experiment, and a later one made by Dr. Lodge, it was deduced that heavy films were most suitable for the purpose of manifolding in this way.

The experiment of Prof. Thomson was made with a small Wimshurst machine—the entire number of discharges allowed to pass during the exposure amounting to 1,200. Two small Leyden jars were connected to each pole of the static machine. If any further experiments were ever made, no report thereof has been recorded whatever; therefore it still remains an open question as to the efficacy of results obtained by the use of a large induction apparatus and a "hard" vacuum tube of high efficiency.

It is true, however, that the number of sensitized papers making up the "multiple-senso-block" must necessarily be limited in all cases, owing to the divergent character of the X-ray emanation, causing distortion at certain distances from the active tube. The same objection applies to the size of the phototype employed, so limiting its surface area. The latter may be overcome as described later. That the process of typoradiography is not a theoretical dream is self-evident and a systematic method of procedure is herewith described.

In regard to the practicability of this process, it may be said to overcome, first, the cost and labor of composition; secondly, the limited time of striking off copies, and, thirdly, the advantage of keeping the entire work a total secret from the printer—a very valuable fact not to be overlooked in diplomatic documents, letters, communications, etc.

Again, the matter to be typoradiographed need not necessarily appear in type characters, but can be written, permitting of actual reproduction of the original.

Before taking up the several results to be obtained a description of the preparation of inks (printing and pen) may first be undertaken.

From our knowledge of the rays, we know that any opaque matter, preferably metallic, can be employed for either. A suitable writing ink for pen use may be composed of:

Red lead ($Pb_3 O_4$),
Gum arabic, powdered,
Glycerine,
Water to make proper solution.

For type work a semi-fluid mixture of red lead, potassium bromide and glycerine sufficient to make a paste.

The above are very opaque mixtures, as will be seen by referring to the following, wherein lead is compared with the standard of opacity prepared by Profs. Batteli and Garbasso:

	Sp. Gr.	Transparency to X-rays.
Water	1.00	1.00
Pb	11.38	0.055+
Hg	13.59	0.04+
Zn	7.20	0.116
Bismuth	9.82	0.075
Glycerine	1.260	0.76

These inks will, however, only permit of white text on a black background, unless certain photographic methods are followed, as in the employment of "upset developers." Therefore a second or "unfatty" ink which will permit of black characters on a white background must be made. These are made preferably of bichromatic mucilage to be used for the letters while the remainder or white portion of the phototype is rendered opaque by a fatty ink. The bichromatized ink of course must not have been exposed to light previous to using to retain its necessary non-adherent property. The fatty ink applied with the usual ink roller will adhere to the unwritten portions of the paper, leaving the letters uncovered or free for the penetration of the X-rays.

Metallic Dusting Process.—A third method of preparing the phototype is to print or write the text with an adhesive or mucilaginous ink composed of tacky varnish or gum (ordinary printing ink does well) and then dusting it over with some opaque metallic powder such as biniodide of mercury, zinc oxide or lead oxide.

The copy will have to be "blown off" to render the characters clear cut and the unused spaces free from mottling opacities resulting from retained dust, or the letters may be written with the non-metallic ink, the remainder of the surface being dusted upon a previously gummed copy, thus giving a black text upon a white background.

The Phototype or Copy.—Where a cryptographic copy is not desirable—as that is limited to single sheets and cannot be reproduced on both sides of the paper by the X-ray process, the text is written by the ordinary typewriter, using either one of the two inks described—the non-fatty being of course the desirable one.

The ink is applied to the ribbon, tympan or roller-pad in both cases. It can be readily seen that a fairly correct copy can thus be prepared with no more than usual care, as single letters or even words can be rubbed out and replaced by correct ones.

Correcting Proof.—The wrong or misplaced text can be eradicated, erased or pieces of the sheet may be cut out entirely—new matter being pasted in, as it were, without injury or damage to the typoradiograph to be made.

The advantage of this will readily be understood by those acquainted with the need of resetting of typographical matter; remembering that that part of the paper not covered by opaque ink will remain entirely permeable to the rays. By reference the reader will notice that but little has been added thus far with the exception of ink preparation, to the facts contained in the methods advanced by M. Izambard, of Paris. In the remaining portion of this paper the author points out the material improvements made by him.

The Sensitive Paper.—The alternately lined face and reverse sensitized paper prepared by Izambard is quite practical, but there is great doubt in the proper developing of a senso-block composed of such, even when layers of blotting paper are interposed between the sheets, as suggested. It is very doubtful if such a block will be evenly distributed by any mechanical process; besides, the blotting paper will naturally have very material objections, to wit: 1. An added expense. 2. Added density hindering free X-ray action. 3. The absorption of large quantities of developer. 4. Loss of absorbed developer unless proper and difficult means are employed to regain the same for further use.

Inasmuch as special machinery must be devised to sensitize the paper, that is, rulings of gelatino bromidized film, I would suggest the making of a continuous strip of paper, sensitized in such way that when folded to the proper size it will still retain the features of a single sheet.

The collected senso-block, after having undergone all the photographic processes can be trimmed in so short a time that I dare hardly make a comparison between the time occupied

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in distributing the separate sheets, before mentioned, in the developing tank.

For single-sheet work the expense of manufacturing film strips of such nature as just described would be still smaller. Figs. 1 and 2 will give some idea of the sensitized strips described.

Paper of fair textile strength should be used. Machine folding

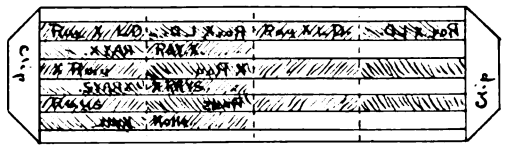

FIG. 1.

is to be preferred, because irregular folding will result in breaking the paper owing to the brittle nature of the dried film. The method of developing this continuous sheet will be described in full detail under its separate heading. Excluding the making of two-sheet reading cryptoradiographs, which is still a question in my mind, because of the inability to confine any man's penmanship to an encroached space, the sensitized paper should contain a gelatino-bromidized film of extra thickness. When single sheets are used they may be superposed in a bundle, having, for reasons described later, a sheet of tissue paper between each.

This collection or bundle of folded printing paper for convenience sake we might call the senso-block. For the senso-blocks of either single or double sensitized sides, it is necessary to make some such mark on the light-proof covering or wrapper which should be used in all cases to enclose the whole block, of say, 100 sheets as a guide to the printer. An ordinary rubber stencil and common ink may be used for the marking, using a letter or character to indicate the "up" side. It will be plainly seen that this fact is important upon referring to the kind of film strip just described.

The senso-block described is brought into the radio-printing department, care having been taken not to expose it to the action of the X-rays. It is mounted or clamped into a form, described later—sensitized side up, upon which the phototype or copy is laid—facing up, and is thus subjected to the action of the rays at a distance corresponding to the efficacy of radiation, and its depth, to prevent angular ray distortion. For ordinary printing a distance of from 10 to 16 inches is necessary, according, of course, to the size of the sheet to be printed. Large sheet printing will be described later.

The current is turned off, after an exposure of about 10 or 12 seconds, or even less, the copy removed from the block, which is

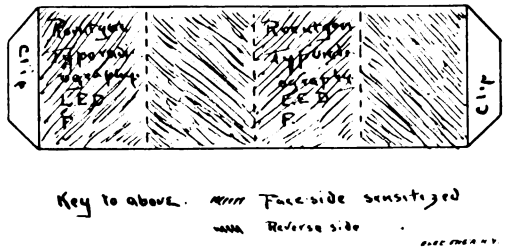

FIG. 2.

brought into the dark room for developing. In making the double-reading, or sheets impressed on both sides, another method than the above must be adopted. For this purpose the double senso-lineated paper or strip must be used. The copies or phototypes are prepared as for the single-sheet process, one for the face and the other for its reverse side. "Type-high" spacing must be used in writing; in fact, it is best to allow a slight space above and below the text; otherwise the head and feet of the letters will result in what is known as "fulling"—a blurring of those parts of the letter. It is essential then to have the letter somewhat shorter than the space allowed it.

The copy, with its reverse reading copy accurately pasted on the back of same, is then laid, face up, upon the "up" side of the block, and upon this the "face" form-plate is placed.

The type will naturally fall into its proper place; there will be no need of straightening the type-block, as there is none in this case; letters cannot be falling into "pie."

At the base of the senso-block a "base" plate is approximated and the whole arrangement is clamped together and locked by the use of bolts, as shown in Fig. 3. Guides could be placed on the reverse sides of the plates to accommodate certain sized senso-blocks, to prevent shifting of copy and block.

Fig. 4 illustrates a form face-plate containing the light-proof wrapped senso-block and typograph. When the copy is locked up into the form, as illustrated below, it is, of course, understood that the copy has been previously prepared to give resulting typographs according to the character of style desired. The exposure is then made as ordinarily.

The various possible results to be obtained may be tabulated as follows:

Single Sheet.

1. Cryptoradiograph—White text, black paper.
2. Cryptoradiograph—Black text, white paper.
3. Typoradiograph—Black text, white paper.
4. Typoradiograph—White text, black paper.

Double Sheet.

5. Typoradiograph—White text, black paper.
6. Typoradiograph—Black text, white paper.

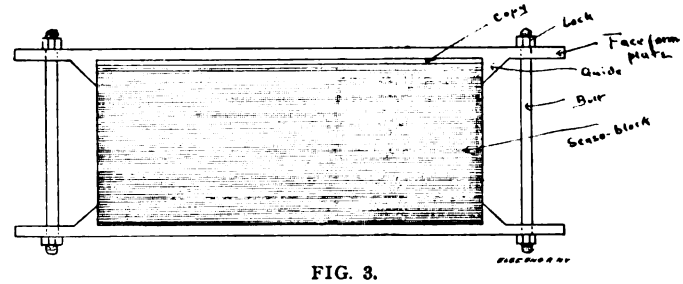

FIG. 3.

Cryptoradiography.—In making multiple copies of autograph matter, the same rules apply as in the latter case. The copy is locked in with an open-face plate, as already shown.

There is a certain advantage in this method, for the reason that the copy can be enclosed in an envelope and its contents never be known except by the writer and recipient, because the sensitized cryptoradiograph can also be made with the sensitized paper placed in a sealed, light-proof envelope, which can have been previously addressed.

This will necessitate a later development in the hands of the person to whom the matter is addressed, which may be considered far less troublesome than preparing a cipher by code, etc. The expense and time for the former process is indeed insignificant as compared to the latter.

Any photographer might develop the cryptoradiograph, but to overcome this the receiver of such matter could be instructed, in less time than it takes to tell, the process of developing and fixing. This method might readily be applied to sealed government orders, instructions, matters of state, diplomatic correspondence, war orders, etc.

Perhaps a secret process of sensitive paper making and their developing will soon be suggested for such matter, the value of which will be seen to apply to orders carried by special envoys, spies, secret messengers, etc. Such copy found on any person captured would only contain a blank piece of paper that would not respond to any but one single developer, the composition of which would be a government secret, known to but few, or even one official. This overcomes the former use of invisible inks (read by heating the paper or by chemical treatment), etc.

The above does not refer to written correspondence alone, but

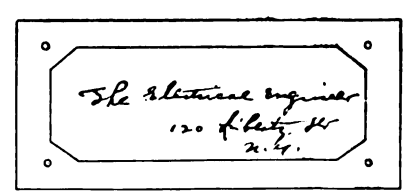

FIG. 4.

to maps, drawings, music, etc. The disadvantage of this process is that only one sheet can be employed, and that the envelope containing "copy" must be of the same size—the copy cannot be folded.

Printing Large Sheets.—Where large sheets are to be printed

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a single tube cannot be used, because of the distortion produced by the cone-like form of the radiations, the apex being practically at the cathode disc or electrode with its base as the object, as shown in Fig. 5. With the ordinary Crookes vacuum tube, from whose cathode the rays are given off to all sides, the latter being the centre of radiation, the rays diverge more and more on all sides as the distance from the tube is increased. To overcome this it has been proposed to use a number of tubes, placed at certain distances apart, with dividing sheets of steel or lead between them, to overcome the ray interference which would otherwise result. It will be found necessary to use separate apparatus of similar efficiency for each tube, to get an equal depth of shadow and penetration.

Small Sheet Printing.—Where but small typoradiographs are to be made, the "senso-blocks" may be circularly arranged around the X-ray tube—that is, the ordinary Crookes type—not of the focus style. In such a way a certain number of exposures of like density and exactness could be made at one time. The table might have a circular top, open in the centre for the tube, which hangs suspended by its single connecting wire from the ceiling or a proper support. A number of sliding shelves can be so arranged that the senso-block placed upon any one of them can be moved toward and away from the tube. The shelf-like arrangement will also permit of various sized copies with senso-blocks of varying thicknesses to be made.

The Exposed Block.—After the block to be printed has been exposed, it is taken to a dark room to be developed. The de-

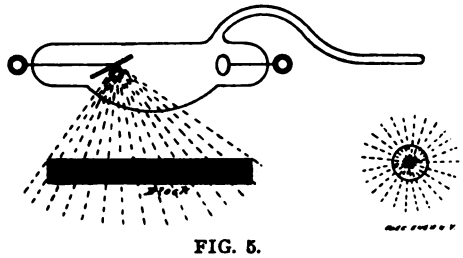

FIG. 5.

veloping should be done automatically, and here I point out the advantage of the strip senso-paper.

The wrapper of the block is removed, one end of the strip is attached to a band, which is made to travel to and fro over a series of rubber rollers. When the entire strip has been unwound its final clip is attached to the other end of the band, and the framework is placed into the tank containing the developer. Here it is kept in motion, either rotary or lateral, until the desired result or density is obtained. The developer could be of mild strength to prevent "flashing up" or "grazing" by overdevelopment. It is to be kept in mind, in speaking of this process, that the operator is not working for details, fine shadows or high-lights. It is simply a commercial chemical process, and would actually need little attention. Paper of fair textile strength should be used.

Another point in favor of this method of printing is that the paper need not have the fine finish now necessary for portrait work, because the X-rays will leave an exact shadow of the impermeable typeletter upon the roughest quality of paper, owing to their peculiar wave propagation.

The block, in case of single sheets, may be quickly broken up under the effect of liquids, because of the interposed sheets of tissue which will absorb enough developing solution to actually act upon the sensitized film, even should several sheets thereof remain unseparated. The tissue will have a tendency to adhere to the sensitized surface, owing to its rather smooth surface. while the opposite page, or reverse side of another, will not stick as much. However, agitation will separate the block quickly, especially if the developer is kept moving, as it should be.

A uniform density is the goal of automatic developing. The developed prints are then collected and put into the washing tank and cleansed of all traces of the developer, the same arrangement being used in this case where the strip is used, then put into a third tank containing the fixing solution, wherein they are allowed to remain about 10 minutes until the entire amount of hitherto unusued silver has been removed. From here they are put back into the washing tank and thoroughly cleansed of all traces of hypo, which takes about 20 minutes. If artificial drying means are to be employed to hasten the process, the prints or strips may be placed in a 3 per cent. solution of formol to harden the gelatin, or a chemical compound having great affinity for moisture might be used. The prints are then ready for distribution, or, in the case of the strip film, they are again folded and cut, unless it is thought advisable to run them through steel steam rollers to smooth and polish them.

If, with all difficulties that might arise in the form of poor ink, apparatus, etc., overcome, blocks containing, say, fifty sheets of paper are used, and twenty blocks are arranged around one tube, then we might have 1,000 copies in 10 seconds' exposure, or 6,000 copies per minute for each tube employed. There is no limit to the number of tubes and blocks to be used if a sufficient number of photo-types are furnished, as separate printing tables can be used in one department, placed at safe distances to prevent clouding the films of sensitized papers of adjoining ones.

This means that if ten tables are used on one floor of fair area, each holding 20 senso-blocks, 60,000 copies could be made in one minute at so nominal an expense of operating that it may practically be counted at the rate of ordinary printing wages for the number of men employed at every table, with an addition of 20 per cent. for the outlay in tubes, apparatus and current.

The extensive use of sensitized paper would bring the cost down enormously from the present market price, while the time of developing, fixing and drying would remain but a very small item.

A man earning $4 per day of 8 hours could, having every facility for work, make at least 250 exposures during that time, which represents, at a moderate estimate, 750,000 copies a day per individual. Ten men working on this basis could produce, then, 7,500,000 copies a day, which could also be developed, fixed, washed and dried within one working day. These figures are startling but perfectly practicable.

Perhaps the addition of an expert radiographer to the corps of printers would prove of considerable value, and still keep this process of printing at a far lesser expense than the ordinary press printing of to-day. Too often has it been said, of late, that the nonsense of forty years ago is the science of to-day; but it may be taken for granted that typoradiography of to-day will become an important and useful art within the next five years to come.

Vibrations of the Ether.

A very interesting papers was read by Mr. F. W. Brauson, F. I. C., before the Leeds Naturalists' Club and Scientific Association on some recent discoveries in physical science.

Attention was first directed to the dissimilarity of radiations transmitted by the atmosphere and by the ethereal medium which pervades all space. Experiments were made with sound waves to illustrate the former, and with the Hertzian waves the latter. The gradations which may be observed between sound, light, heat and electrical waves were demonstrated by means of models and diagrams, and a table showing a number of vibrations per second of various radiations was given as follows:

Vibrations per second.	
288,224,000,000,000,000	Röntgen rays.
1,125,899,906,842,624	Photographic limit of solar spectrum.
562,949,953,421,312	Green light.
281,474,976,710,656	Infra red (photographic limit).
70,368,744,177,664	Heat rays of solar spectrum, lowest direct measurement.
67,108,864	Electric oscillations in Hertz resonator, 70 cm. diameter.
32,768	Audible vibrations, extreme upper limit.
4,096	Music, highest note.
32	Music, lowest note.
16	Water surface waves of minimum velocity.

The system of wireless telegraphy used by Marconi was then demonstrated by means of Hertzian waves emitted from a Hertz radiator. A number of experiments with phosphorescent bodies, etc., and the Röntgen rays, were then shown, and, by means of a Tesla coil, so arranged as to give a rapidly alternating field, tubes of high vacua were illuminated without the intervention of conducting wires. The experiments were very numerous and of the greatest interest, and a large attendance of members testified to the appreciation of the labor which their preparation must have entailed.

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ELECTRIC LIGHTING.

Features of British Central Station Practice—Carlisle and Cork.

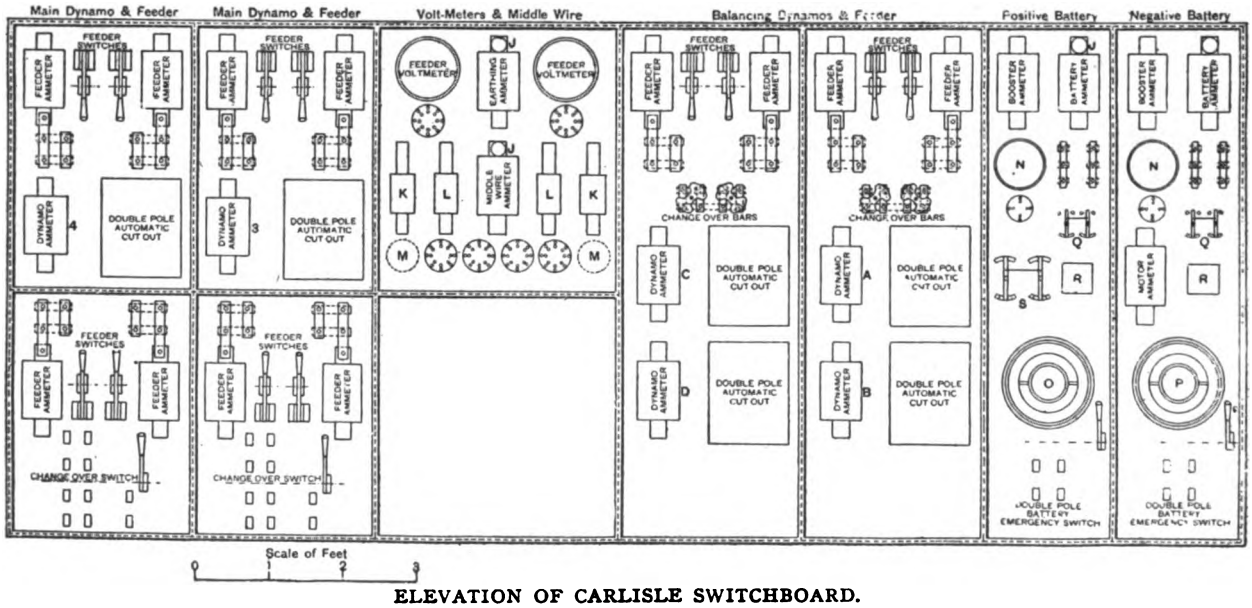
TO American engineers and manufacturers whose ideas and apparatus have of late years been so largely endorsed and adopted in a most flattering manner by their English and Continental brethren, central station practice abroad has always been a subject of considerable interest. It shows them how their ideas and apparatus are being installed and utilized and what modifications have been made to suit local or perhaps general conditions, besides suggesting to them improvements or opportunities for radical departures. In view of this tendency, we published a few weeks ago descriptions of several English lighting and power stations of considerable size and importance, and below we present two more recently completed stations of modern design.

CARLISLE ELECTRICITY SUPPLY STATION.

This station, a plan of which is shown below and which will shortly be put in operation, was designed by Prof. A. B. W. Kennedy. At present it will only serve for the lighting of the town, but it is proposed to erect an electric tramway system which will be fed from the same station. The system adopted is the three-wire system, with an earthed middle wire and 460 volts between the outers. Steam-driven balancing dynamos are used, and a battery. The boosters are arranged so that they can be used in series with the cells, and add to the voltage of the dynamo during charge and to the voltage of the cells during discharge. During light loads the voltage is regulated by cutting cells in or out, and the cell-regulating switch is interlocked with the booster reversing-switch by a special arrangement designed by Prof. Kennedy, which facilitates the switchboard attendant's duties and insures against error. This is one new feature of the Carlisle station; another exceptional feature is the provision to be made for utilizing the dynamos either for the 460 volts lighting network or the contemplated 500 volts railway system. For the former purpose they are used as shunt machines; for the latter, a series-winding is added, and they run compound. The arcs used for public lighting are connected 10 in series across the 460 volt mains.

The station is situated at the corner of James street and the Victoria Viaduct, and has the advantage of a siding from the Caledonian Railway. The plan and sectional elevation show the general arrangement of the station and the disposition of the machinery and plant. The boilers are of the Lancashire type, 28 feet by 8 feet, manufactured by the Oldham Boiler Works Company, each with two internal furnaces, 3 feet 3 inches external diameter. A working pressure of 160 pounds per square inch will be empolyed. The steam pipe connections are shown in the illustration; it may be mentioned that in their erection this arrangement was departed from, but to a very slight extent only. The main lines of pipe are 8 inches and are of steel, while all the bends and all the pipes of 4 inches or less in diameter are of copper. A Green's economizer is employed. The condensing water pumps are electrically driven, the water being obtained from the river. Four Ledward ejector condensers are used, two capable of dealing each with 4,000 pounds of steam per hour, and two dealing with half that quantity. In these condensers Messrs. Ledward have not departed from their standard pattern.

The two main steam dynamos are of the Willans-Siemens type, running as shunt machines at 330 revolutions per minute, and generating 255 amperes at 490 volts (maximum), or as compound machines at 350 revolutions when they are capable of giving 227 amperes at 550 volts. These are supplemented by two pairs of balancing dynamos, each pair being coupled to a Willans engine. Each dynamo of these "double-enders" will generate 123 amperes at 245 volts when running at 450 revolutions per minute. The booster consists of three upright bipolar machines of the Electric Construction Company's standard type, mounted together in line on a substantial bedplate, which carries four self-oiling bearings; the centre machine is the motor which is shunt wound and is for an e. m. f. varying from 460 to 520 volts; it provides the driving power for the two outer machines or boosters proper. These are each capable of giving any current between 0 and 60 amperes at any voltage from 10 to 70 volts, with capacity for a maximum load of 120 amperes. The dynamo armatures are connected to the motor armature by flanged couplings for easy separation and removal. As already mentioned, the booster will be used principally for charging and discharging the battery when the e. m. f. at the omnibus bars is either lower or higher than the e. m. f. of the battery.



ELEVATION OF CARLISLE SWITCHBOARD.

The switchboard, having some points of novelty, we illustrate it by both an elevation and a diagram of connections. At present the board can deal with two generators, two sets of balancing dynamos, a motor with double booster, two batteries (one on each side of the system) and four lighting feeders. Provision is made so that two additional panels with necessary switching gear can be added for connecting the two main generators to either lighting or traction bus bars, and for two traction feeders. The proposed arrangement is shown in the illustrations, for the sake of completeness.

Each of the main generators has in circuit on the switchboard a double pole automatic magnetic switch, a Kelvin sector pattern ampere gauge with circular dial, and plug bars. The latter are to enable the machines to be connected to either of two sets of bus bars. The automatic switches act as maximum or minimum cut-outs, and also as manual switches, and they have carbon breaks. The two panels for the main generators are on the left, and each also carries two feeder switches and two Kelvin

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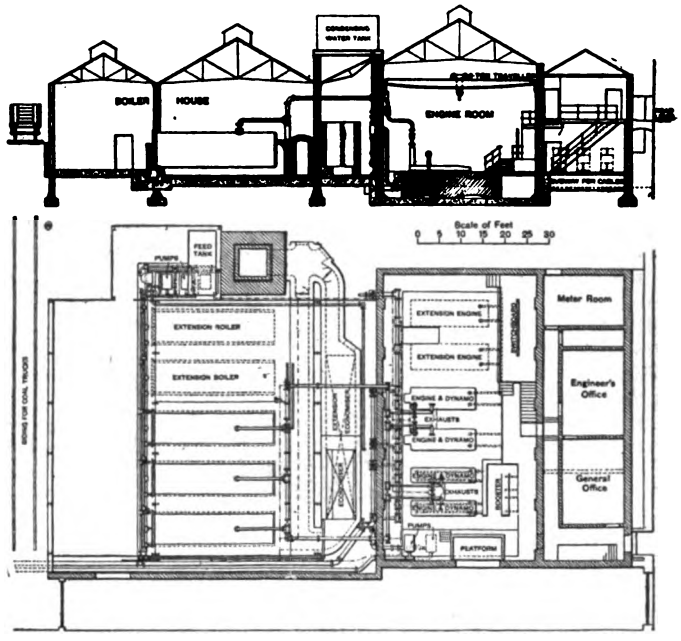
edgewise ampere gauges on the two poles of one feeder. The feeder switches have connected in parallel with them a light fuse for breaking the circuit, the fuse being fixed in a convenient position, but not on the board. The balancing dynamos have the same switching gear as the main dynamos with the addition of a set of change over bars, so that they can be connected to either side of the system. The panels for these are the fourth and fifth from the left. They also carry feeder switches and ampere gauges, as in the case of the main generator panels. The two right-hand panels are for the batteries and motor boosters, and have mounted on them booster ammeters, battery ammeters, booster voltmeters and multiple way switches, motor ammeter, plug bars to connect the booster either to the battery, "milking" leads, or to a meter-testing circuit, a motor starting switch, booster field breaking switches, battery emergency switches, battery regulating switches and booster reversing switches. These latter two are interlocked, as has already been mentioned. The battery switch has eleven contacts and a double brush, arranged as in the diagram. From this the various connections are evident, and no further description is necessary. The ammeters on these panels are also of the Kelvin type, and the voltmeters are Weston. The third panel from the left is devoted to the middle wire instruments, and to the dynamo bus bar and feeder voltmeters. There are four voltmeters for the dynamos and bars, of the Kelvin type, and two for feeders of the Weston type, each provided with a double-pole multiple way switch; also an ammeter for the middle wire and one for the earth connection. The panels are of slate, 2 inches thick, enameled back and front. The framework is built up of steel tees and angles; it is 17 feet long, 7 feet 3 inches high and is surmounted by an eight day clock.

All the feeder ampere gauges are of Lord Kelvin's edgewise sector pattern, with scales. The principle of this instrument is the same as that of Lord Kelvin's ordinary sector pattern ampere gauge. These contain a solenoid giving an exceedingly intense and uniform field, this solenoid being so constructed that the axis of the field passes through the axis of the solenoid. Into the solenoid is entered a soft iron plunger suspended from an aluminum sector which, together with the pointer and suspension bar, forms the movable system. The current passing in the solenoid attracts into it the soft iron plunger, and this movement is indicated by the pointer on the scale. The zero is at the bottom of the scale; and an increase of current is shown by a rise of the pointer. These instruments are fitted in strong cast cases with nickeled facing, forming a thoroughly substantial piece of apparatus, and at the same time having the accuracy of reading of a high class instrument. The Kelvin voltmeters are of the small dial engine room type, a special feature in which is a short scale giving only the part of range that is required, and consequently very large divisions.

To avoid crowding the diagram, all the connections to the voltmeter switches A, B, C, D, E and F are not shown in the plan of connections. A and D can connect their voltmeters to either of the main generators, 3 and 4, A on the dynamo side of the cut-out and B on the bus bar side. They can also be connected between the top and bottom bus bars respectively. B and E can be connected in the same way to the balancing dynamos, A, B, C and D, B on the dynamo side of the cut-out and E on the bus bar side. B can also be connected between either positive bus bar and the middle wire, while E in a similar way on the negative side. Lastly, B and E will also give the voltage between cell 125 or cell 115 and the top negative and positive bus bar respectively, inside the battery switch. C and F in their lower positions connect their voltmeters between the booster terminals, in their left-hand positions between the terminals of the positive battery and emergency and regulating switches respectively, and in their right-hand positions between the terminals of the negative battery and the regulating and emergency switches respectively.



PLAN AND SECTIONAL ELEVATION, CARLISLE STATION.

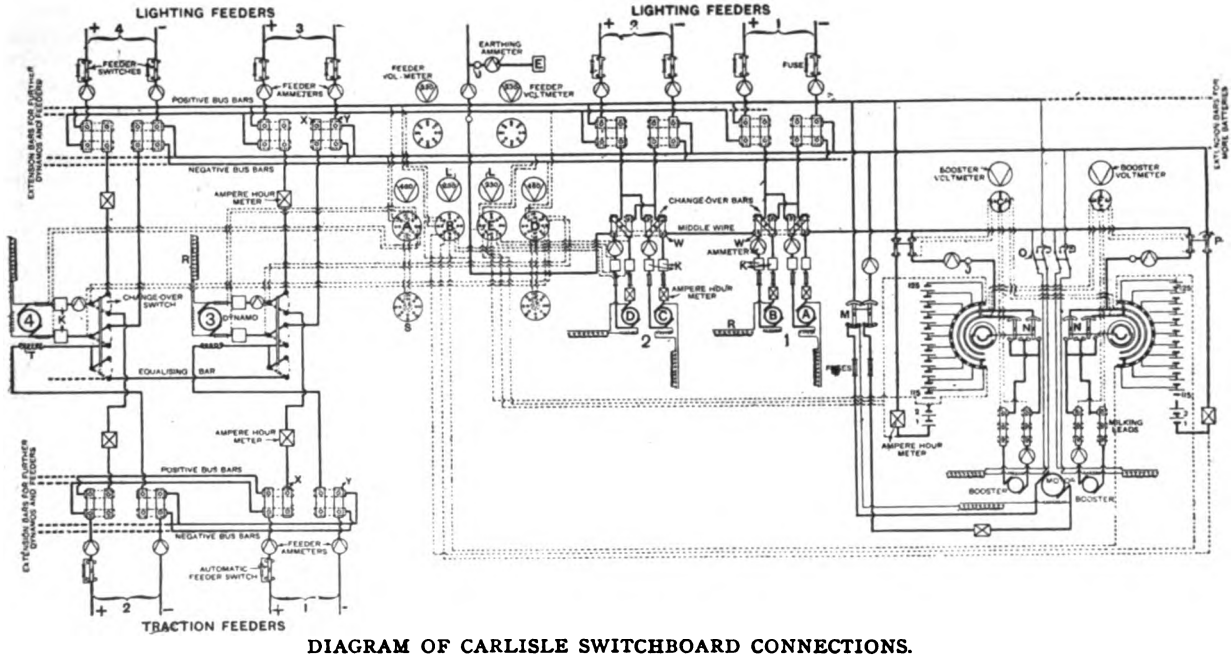


DIAGRAM OF CARLISLE SWITCHBOARD CONNECTIONS.

There are two batteries, each of 125 Chloride cells, at the station itself. The minimum capacity for a five-hour discharge was specified to be 300 ampere hours, and the cell was to give without deterioration 90 amperes for three hours, or 120 amperes

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for 30 minutes, in each case without a lower e. m. f. than 1.86 volts per cell being attained. The cells are in glass boxes and supported, as usual, on oil insulators.

CORK ELECTRIC LIGHTING AND RAILWAY STATION.

The distinctive feature of the recently completed works at Cork is the combination of lighting and tramways. The following details of the scheme have been furnished by the chief contractors, the British Thomson-Houston Company.

The plant comprises three Babcock & Wilcox boilers, each having 2,531 square feet of heating surface, capable of evaporating 8,000 pounds of water per hour, the normal working pressure being 150 pounds. A somewhat novel form of chimney stack is employed. It is of steel, and, although 130 feet high, is self-supporting. It is 7 feet internal diameter, and lined with 4½-inch fire brick, and is erected on piled concrete foundations. A feed heater of the Wheeler Condenser and Engineering Company utilizes the exhaust of the feed and condenser pumps. Blake & Knowles feed pumps are employed. They are arranged compound, the diameter of high pressure cylinder being 6 inches, low pressure cylinder, 9 inches; water cylinder, 4 inches in diameter, with 8-inch stroke. The steam cylinders of these pumps are fitted with an improved outside valve gear, so that they can be adjusted full length of stroke under all conditions of speed. The steam connections of the pumps are so arranged that, in case of any repairs being required, either pump can be worked independent of the other.

The hot well is situated in the boiler house, and is fitted with baffle plates, the divisions in which can be filled with coke and straw, if desired, for the purpose of intercepting any oil that may be discharged into it. It is fitted with suitable outlets, so arranged that by opening a valve and filling the tank, the oil, which will be found floating on the surface, can be run off.

The feed water, before entering the boiler, can be passed through two Edmiston filters, capable of filtering 16,000 pounds of water per hour. These filters are arranged on a twin system, fitted with the necessary valves to enable the filters to be used on either range of feed pipes.

The steam piping is of steel, fitted with heavy screwed steel flanges, so arranged that any engine can be fed direct from the boiler immediately behind it. The necessary valves are inserted to enable any faulty section in the piping being cut-out. This piping is fitted with an automatic atmospheric valve, which, in the event of there being any pressure due to the failure of the condensing plant, will immediately allow the engines to exhaust direct into the atmosphere. The piping on the atmospheric side of this valve is of thin steel, riveted together in spirals.

In the engine room are three McIntosh & Seymour side-crank tandem compound condensing engines, running at 135 revolutions per minute. They are fitted with expansion governors; there being separate exhaust valves on both high and low pressure cylinders. The high pressure cylinder is steam-jacketed and exhausts into a receiver, in the interior of which are fixed three copper coils, which can be heated with live steam. These engines are coupled direct to 6-pole 200-kilowatt compound-wound generators, giving 500 volts at 135 revolutions.

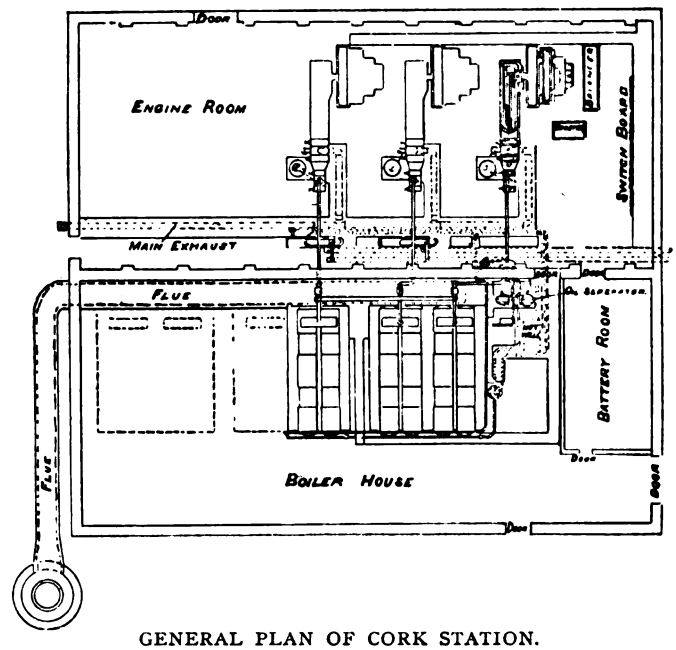
There are two Wheeler Admiralty type condensers, the engines being in the centre, an air pump at one end, the circulating water pump being at the other end. Each combination is capable of dealing with 12,000 pounds of steam per hour. Water is taken direct from the river through 12-inch cast iron pipes, there being an auxiliary supply from the water works, which can be laid on to start the pumps in the event of the suction pipe being emptied, through the retaining valve not being perfectly water-tight.

The battery room contains 256 Tudor cells mounted in three tiers, each cell containing six positive and seven negative plates, the capacity of the battery being 770 ampere hours, the normal rate of discharge 110 amperes, and the maximum rate 210. The battery stands are of pitch pine, coated with acid-proof paint, and mounted on large oil insulators. This battery can be charged either from traction or lighting bus bars as desired, the necessary volts for charging being supplied by a booster, which can also be driven from the traction or lighting bus bars. The switchboard is at the end of the engine room, and contains:

(1) Three generator panels, fitted with automatic circuit breakers, with magnetic blow-outs, as well as the necessary switches, so arranged that the generators can be connected direct to either the lighting or traction bus bars.

(2) Two battery panels, fitted with necessary regulating switches and magnetic blow-outs, and arranged so that the battery can be either charged from, or discharged on to either the lighting or traction circuits as desired.

(3) Two balancer panels, arranged so that the balancer can,



GENERAL PLAN OF CORK STATION.

if desired, in the daytime, be driven direct from the traction bars or used as an ordinary balancer, the two motors being in series across the outers, the junction being connected to the neutral; in this case, the set being run up to give its correct voltage by means of the motor placed in the centre, the electrical connections to which are disconnected after the balancer sets are connected to the network. The switchboard is also fitted with a panel containing the necessary instruments required by the Board of Trade for purposes of testing.

The lighting distribution is on the three-wire system, with 460 volts between the outers, the mains being all of Messrs. Callender's manufacture, and in the majority of cases consisting of jute covered, lead sheathed, tape armored cables, laid direct in the streets.

Altogether over 20 miles of cable (lighting and traction systems) have been laid; the distance between the feeding points (of which there are two at present) and the station being just under half a mile. In their course from the power station to the feeding points, the cables cross the River Lee, and as there is only a swing bridge at this location, the cables had to be laid in a trench excavated in the bed of the river; Callender's vulcanized bitumen wire armored cable being adopted as most suitable for the purpose. Four additional spare feeder cables, each of .7 inch sectional area, have been laid across the river to cope with future extensions; the vulcanized bitumen cables being brought together in a pit on each side of the water, where they are connected to the ordinary jute covered, tape armored cable laid in the streets.

We are indebted to the London "Electrician" and the London "Electrical Review" for the above details and illustrations.

CLEVELAND, O. The Cleveland Illuminating Company has offered arcs at $89.88 for the year 1899, but is being squeezed by threat of a municipal plant, for which the city has not got the money.

NEW YORK CITY has not yet renewed its lighting contracts, and the various companies are continuing their work until such time as the Municipal Assembly can get around to the subject and do its duty, by passing the necessary resolutions as to bids and appropriations.

NEWARK, N. J. The C. P. Power Co., 784 Broad street, has been formed to manufacture current, etc., with a capital stock of $200,000. The incorporators are: F. W. Yates, F. W. Roller and G. E. Snider.

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Why Some Small Electric Light Plants Do Not Pay.—II.

(Concluded.)

BY J. R. CRAVATH.

EACH transformer, before being accepted and put on the lines, should be tested for core loss, that is, the constant loss of energy that is taking place as long as the transformer is connected to live lines. This can easily be done with an indicating wattmeter, of the kind used also for testing lamps. Several companies now make indicating wattmeters suited to this purpose. To test a transformer for core loss, it is only necessary to connect its secondary to the secondary of some other transformer already in operation on the lines. Then by connecting a wattmeter so as to measure the energy supplied to the secondary of the tested transformer and leaving the primary circuit of the transformer that is being tested open, the energy lost in the core of this transformer can be read directly from the wattmeter. A number of transformers can be tested in a very few minutes in this way. If the transformers are new, this core loss should not exceed 30 watts in a 20 light converter, 40 watts in a 30 light converter, 50 watts in a 40 light converter and 60 watts in a 50 light converter. A general rule on the smaller sizes which may make these figures easy to remember is that the core loss in watts should not be more than the capacity of the converter in lamps plus 10. If the transformers are second-hand and coal is cheap, these figures may be stretched a little, but there is no excuse for new transformers not being up to this standard, as many makers are doing far better than this. If an indicating wattmeter is not at hand, the core loss in a transformer can be tested with a common recording wattmeter such as is used for measuring current supplied to customers. This should be of low capacity (10 lights being usually the lowest obtainable) and the test, to be correct, should cover several hours. As wattmeters are liable to run slow on such a small load as the leakage current of a transformer, it is best to put a load of lamps on the wattmeter in addition to the transformer. For example, if it is a 10-light wattmeter, connect a load of nine lamps to it and note the amount of energy supplied to the lamps in a certain time. Then in addition to the nine lamps connect the secondary of the transformer to be tested in multiple with the lamps, and note the amount of energy consumed for exactly the same length of time as in the first case. The difference will be the amount of energy lost in the transformer provided the voltage is the same during both tests, and the lamps have not had time to change with age. In order to be sure that these two chances for error are eliminated it is well in the small station to make the first test covering about five hours on one day and the second the corresponding five the next day. If the station voltage is the same in both cases, as it should be for corresponding hours on week days at the same season of the year, and if the same lamps are used in both cases, this test should give fairly correct commercial results. Neither the lamps nor the wattmeter will change much in the course of a few hours and therefore the comparative results are not rendered incorrect, as they might easily be if weeks or months should intervene between the two parts of this test.

Another most important point to be observed in accepting transformers, especially if they are not new, is the insulation. It certainly is not good business policy to accept and put on the lines, transformers that will burn out with the first thunderstorm, or perhaps get a leak between primary and secondary that will result in killing or severely shocking some unsuspecting customer. And yet it is safe to say that in the majority of alternating plants there are transformers that are a constant menace to persons handling lamp sockets on the secondary circuit. That the writer is not now in the happy hunting grounds on account of a leaky transformer of this kind, is due more to good luck than to any more rational cause. Few men connected with the smaller plants realize the danger from this source. One good sized personal injury lawsuit would cripple a small electric light company so it could never get on its feet again; and yet transformers are constantly left on the lines until they actually burn out, without any effort to find out whether they are in a condition dangerous to customers, when a simple monthly test of each transformer with a magneto would take no more time than reading the meters, and would weed out defective transformers. To be sure a transformer will be very far gone before even a powerful testing magneto will ring through between primary and secondary, but by testing often enough the dangerous condition can not exist very long. Before putting a transformer up, large stations now make a severe test as to the ability of a transformer to stand high voltage between the coils. To make this test, special high voltage transformers are required. Specifications recommended by various authorities as to the voltage a transformer shall be able to stand between primary and secondary vary considerably. Ten thousand volts (as sometimes specified), after the transformer has been heated by its rated load for several hours, is a rather severe test for a 1,000-volt transformer. Five thousand volts for a 1,000-volt transformer is another specification, and this is certainly none too severe, while at the same time it will let nothing inferior pass. If a small company feels that it can not afford a special high voltage transformer for such tests, it can at least run its transformers for six hours at full load and then apply 1,000 volts between primary and secondary terminals for fifteen minutes. It is also easy to note whether in this six-hour run at full load the temperature of the transformer rises more than 70° Fah. above the surrounding air, and if it does it is not worth putting in service. Now there is nothing about any of these tests spoken of that can not be done around a small plant by the men already employed if they are properly directed. They take very little time when worked in with the nightly station routine, and it is nothing more than good business management to know the kind of apparatus a company is getting for its money, and whether such apparatus is worth buying and fit for use.

Before leaving the electrical engineering part of the construction and operation of a small alternating plant, I want to call attention to the most remarkable method, or want of method, in vogue for securing the proper voltage at the lamp terminals. Upon going into one of these plants one usually finds an alternating current station voltmeter of uncertain age and accuracy run from the secondary of a transformer. Now this transformer may be a special station voltmeter transformer, but it is just as liable to be any kind of transformer that happened to be handy, perhaps partly loaded with lamps in the station, perhaps not. Now, it is likely to make anywhere from two to five volts difference with the absolute accuracy of the voltmeter as indicating the correct primary station voltage, whether it is run off its own transformer or some common transformer partly or fully loaded. Not only is this possibility of error ignored, but the drop in line, transformers, and secondary wiring is ignored, and the station voltmeter is kept constantly at a certain point without regard to the load that is on. It may have been very nice as a theory in the early days of alternating current distribution that the loss in distribution was too small to be counted on, but it does not work in practice. On small systems there is usually a drop of from two to five per cent. in the primary lines between station and transformers at full load. The transformer itself will cause a drop of two to three per cent. between no load and full load, and the secondary wiring is usually calculated (if calculated at all) to give two per cent. drop. We have then approximately between no load and full load the following losses to provide for at the station:

Primary circuit	4 per cent.
Transformer drop	3 per cent.
Secondary drop	2 per cent.
	9 per cent.

This drop of nine per cent. would call for a pressure of 1,090 volts at the station, but as a matter of fact 1,110 will be needed because the real ratio of conversion of all transformers falls somewhat short of the nominal ratio. Thus transformers built to transform from 1,000 volts to 100 will give from 97 to 99 volts on the secondary when the primary voltage is 1,000 and there is no load on the secondary, and from 94 to 96 volts with the secondary loaded and primary pressure 1,000 volts. The proper way, of course, is to always keep the primary voltage two per cent. higher than the nominal ratio of conversion calls for.

Assuming, according to the foregoing figures, that the losses in primaries, transformers and secondaries is nine per cent. on full load, the proper station primary voltage should be 1,020 at no load, 1,065 at half load, and 1,110 at full load, other loads in proportion. Now, it is evident that with a station voltmeter of the kind described, that no one knows the accuracy of, and which really gives no indication of the true primary voltage, it is like going in the dark to try to regulate the pressure by it. There are evidently so many chances of error by it that the only safe way in most cases is to have a good portable alternating current voltmeter, not only for checking the accuracy of the station instrument, but for actually going to the consumers' lamps and determining what station voltage, as indicated by the station volt-

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meter, will give the correct lamp voltage at different loads. A good portable voltmeter for this purpose is by no means an unnecessary refinement, as it is the only sure way of keeping lamps at their proper voltage. Lamps run below their voltage give a poor light and are a very poor advertisement for the electric light in the small towns where gas machines and powerful kerosene burners put up strong competition. On the other hand, the excessive lamp renewals with too high a voltage will pay for a good many portable voltmeters. The case is no better if the customers pay for their own renewals, for they will object to this expense very vigorously.

The adjustment of meter and contract rates is a matter requiring much good judgment and an intimate acquaintance with the electric light business as it runs in small towns, for a mistake in the beginning is very difficult to remedy. Never put the rates very low with the idea of attracting a large number of customers without first considering how many customers it is possible to get, as shown by the experience of plants in similar towns. In a small town, unlike a large city, there is a very limited number of possible customers. The majority of the stores will become customers in time if the service is good. Among the residences, those able to afford electric lights in a small town (unless it is a rich suburban town) are very much in the minority. The income possible is then limited and the company should see to it that in the effort to compete with gas and kerosene they do not put rates down to where it will always be an impossibility for the plant to pay. It is now generally accepted that the only proper way to sell current from a large plant is by meter, but what is to be done in a small town where there are numerous customers taking from two to seven 16 c. p. lamps each? To buy, install and look after a 10-light meter for each one of these is evidently an unnecessary expense since most of these customers are small stores and places where the lights are used a definite number of hours every day, and it is easy to calculate just about how much current will be used and charge accordingly by contract. For all other customers, however, where the demand for light is intermittent, the meter is the only thing and the contract rate a snare and a delusion as far as the company is concerned. Residence lighting by contract is one of the best ways to burn money the writer ever ran across. The man with twenty lights in his residence who "ordinarily wants only two at a time," somehow forgets to turn off the other eighteen enough of the time so that his load is fully equal to that of the stores which pay several times as much per month.

Designers of small stations do not sufficiently realize the value of labor-saving arrangements of building, boilers, etc. Labor is the largest item in small plants, and it is often the case that differences in the arrangement of the plant will constitute the difference between getting along with one man or hiring two. Builders of small steam plants have a favorite way of arranging to have the coal dumped first into a store room adjoining the boiler room, from whence it must be run out in a wheelbarrow in front of the boilers. They also have a fondness for making the space in front of the boilers very limited, so that not much coal can be put there at once, and the fireman's operations in general are impeded. Then, too, according to this creed, whenever possible, the dynamo room, stoke hole, pump and steam gauge should never be put in any handy relation to each other. The engineer that runs the plant when he is not getting out coal from the storage or firing and cleaning fires in the limited room before the boilers, will be kept from getting lazy by chasing around Robin Hood's barn to look at the voltmeter or start the feed pump.. The fact is, the moral effect of such a poorly arranged plant is enough to destroy all sense of discipline or responsibility on the part of the man running it, to say nothing of his inability to look after the plant as it should be looked after, simply because of such unhandy arrangements. And right here it may be said that no matter how limited the force employed around a plant, it is important to the financial success of the undertaking that every one connected with its operation be made to feel a strict sense of discipline as regards correcting immediately any defect that could possibly develop to an extent to cause the shutting down of the plant. As financial reasons prohibit an investment in duplicate machinery to a large extent in small plants, it is of greatest importance that everything be kept in such perfect condition that breakdowns never occur. The steam plant of an ocean steamship is expected to make its run across the Atlantic, covering from one to two weeks' time, without a hitch or shut-down of any kind. It certainly is not asking too much to expect a small electric light plant to run as regularly as clockwork a few hours every day. But it requires eternal vigilance to do it. Breakdowns and poor service usually originate with the business management of a company. If the men find that their carelessness in not reporting or remedying the slightest troubles is overlooked, or if, as is often the case, reports of incipient troubles are ignored, or the ordering of supplies to correct them is delayed, it will only be a short time until everyone about the plant loses all strict sense of responsibility. The personal equation figures very largely in the reliability of the service given by any plant. Dirt and disorder should never be put up with, not so much on account of the injurious effects of the dirt as because of the general demoralizing effect such a condition of affairs and the resultant carelessness as to details. The weighing of all the coal used as it is fired is not practicable in the small plant because of the labor involved, but it is well occasionally to have a test night or two and weigh all the coal, and if possible all the water. Such tests, together with monthly averages, will help determine the best coal to buy, for the best coal is not always the cheapest any more than the cheapest is always the best. There is usually fully as much chance for fuel economy around the boiler room as anywhere, by keeping boilers free from scale, and flues free from soot, properly heating feed water and careful firing so as to avoid leaks of steam through the safety valve and of air through the fire doors.

Finally, I may give as one of the principal reasons why some small plants do not pay is that there is not enough in the business to command the services of a very high priced man in any capacity. While plenty of men can be found who can do the manual work around a plant it is not so easy to find men who are capable of taking charge of everything about the plant and who will do all the manual labor necessary, because such a quality of man can usually find equally paying positions in some larger plant where they can get work more to their taste. The result is that often the plant is managed jointly by some officer of the company who knows nothing by previous experience of the electric lighting business, and by some hobo who does the manual labor and who is equally ignorant of the electric light business. The combination is always an unhappy one for the stockholders. It goes without saying that there should be some one connected with the enterprise who has had some experience in the business, though it matters not much in what capacity, whether as consulting engineer, officer and part owner, or as operating electrician or engineer.

Competition of Acetylene Gas with Electricity.

WE have recently been in receipt of the following inquiry as to acetylene gas, from the manager of a relatively small electric light company in the West:

Dear Sirs—We would like to ask for some information through your columns on a subject that cannot fail to be of interest to the electrical fraternity at large.

There have been several agents for acetylene gas through this town with wonderful tales of its cheapness and other merits. One agent has made the assertion that a light equivalent to a 16 c. p. incandescent lamp could be run 17 hours for one cent. Now I would like to get an opinion from some disinterested party who has actually tried this illuminant on a small installation, and will suppose a sample case. We will suppose a store building 20x 80 ft. that has been lighted by twenty 16 c. p. incandescent lamps at a rate of 17c. per 1,000 watts for current. Now how much would it cost him to install an acetylene gas generator with twenty burners including gas pipe, fittings, etc., to take the place of his twenty electric lamps, and how much would it cost him per hour to run it after installed; also how much of his time would it take to keep the generator in running order, and any other facts bearing on the case?

I feel sure that a reliable comment on these questions will be of enough interest to all station managers, especially those in the smaller towns, to justify your giving it space in your columns.

We have the subjoined comment on the above letter from an authority on the subject of calcium carbide and acetylene gas. He is connected with one of the leading universities, and we have no reason to believe that any views he may express are otherwise than entirely fair and disinterested:

Regarding the inquiry I would say that I have no practical experience in the use of acetylene. Still I may be able to give you some data which should enable any one making some inquiries to compile data of the kind mentioned. The price of an acetylene light will depend on the following factors, which vary according

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to locality, local insurance regulations, dealers' and middlemen's profits, number of lights, etc.:

a. Price of carbide to consumer.
b. Price of generator.
c. Price of installation (possibly separate building for generator).
d. Labor in filling and cleaning generator.

Carbide packed in large tins (100 lbs.) costs at Niagara Falls $70 per ton in lots of more than one ton; in lots of one ton or less, $80. Packing in small tins increases price. Hence the carbide costs the dealer at least $80, plus freight. Dealers sell it in small tins to consumers, generally at very high price per pound. It is impossible for me to name a price for generator or installation; by asking dealers one could get their prices.

One pound good carbide yields an average of 5 cubic feet gas; but for a domestic plant with comparatively small consumption 4½ cubic feet would be a safe figure. A burner consuming one-third cubic foot acetylene per hour gives a 16 c. p. light. Allowing then 4½ feet acetylene per pound carbide, with carbide at $100 per ton, or 4 44-100 cents, say 4½ cents per pound, a 16 c. p. light will cost in carbide one-third cent per hour. It must be noted that this yield of light per carbide used is only obtainable with very good generators, i. e., with those in which the decomposition of the carbide by water does not heat the generator to a point much above the boiling point of water. Most of the cheap generators overheat in making the gas, injuring the quality and quantity of gas generated from a given weight of carbide, to a very considerable degree.

From the data given, knowing

a. The local price of electric light, or gas.
b. Cost of generator and installment.
c. Price charged per pound for carbide.
d. Allowance for labor,

one could get by a little figuring the bottom price for the acetylene light.

I can only add that hitherto in places where a good gas or electric light plant was in operation, the use of acetylene has not been considered economical. Hitherto, however, the demand for carbide has exceeded the supply as well in this country as abroad.

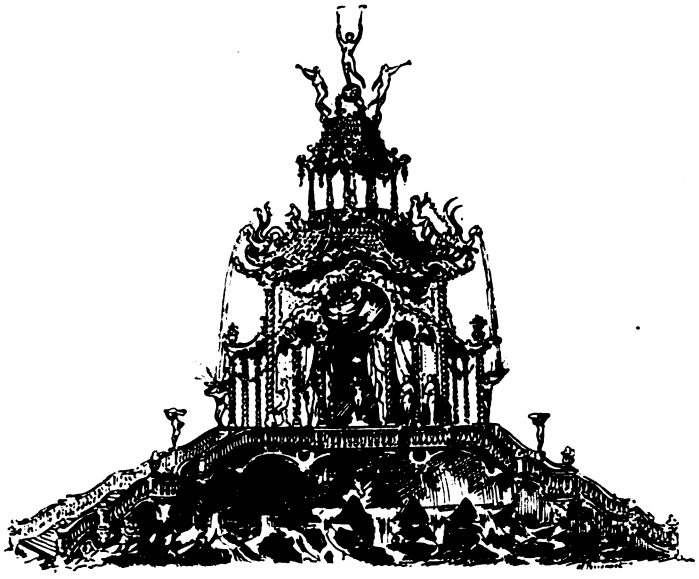
The carbide works in this country, however, are greatly enlarging their capacity, and so many new and very large works are in erection abroad, that it is safe to say the yearly output of carbide will, by January, 1900, be at least ten times the present output.

Again, the generator business and installation business is now something as the bicycle business was seven or eight years ago. If carbide gets so cheap, and the demand sufficient for dealers to sell it in small lots at one-half present rates, and if the generators come down to a reliable standard and fair price, I personally think it very probable that acetylene may compete with other forms of lighting at equal or possibly lower prices per amount of light given. As there is, however, with the newest methods in gas lighting and manufacture of water gas, etc., opportunity to lower the price of gas light one-half, with the same profit to manufacturers, and as improvements in generating and lighting by electricity are of daily occurrence, I fully agree with you in thinking that there is no need for an electric light company or gas company to be alarmed by acetylene.

The subject is one of much interest and importance and we shall be glad to have further contributions that will help elucidate the subject.

The Luminous Palace for the Paris Exposition of 1900.

THE Luminous Palace for the Paris Exposition of 1900 will probably be the greatest piece of glass and stained glass work ever undertaken. It is to measure about 110 feet high and 175 feet in circumference. The designer of this pretty pavilion, of which a view is shown, is M. J. A. Ponsin, whose artistic productions in stained glass are well known. The Luminous Palace, which is being built close to the Eiffel tower, will be rendered attractive by day as well as by night. Its staircases will be of crystal. Its promoters claim likewise that it will display the most curious and beautiful exhibition of electric light combined with a fairy-like arrangement of stained glass and crystal ever witnessed. This gigantic glass building is being executed by la Compagnie des Glacières de Saint-Gobain, France, who are leading makers of French plate glass, etc. The construction is to contain plenty of ornamental sculpture and clever statuary. The façade will present the aspect of an immense portico, the roofs resting on multicolored glass colonnades. Both from the interior and the exterior the palace will be rendered completely luminous. Among the artists who will assist in making the pavilion attractive in the interior are the famous sculptor Falguière, M. Ch. Castellani, and M. F. Beer, who is designing a statue to personate Light. In addition to the pavilion there will be a sub-

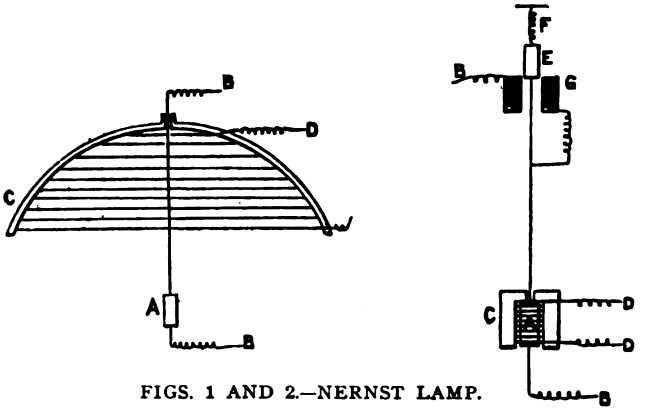


ELECTRICAL LUMINOUS FOUNTAIN OF GLASS, PARIS EXPOSITION, 1900.

terranean crystal grotto imitating ice. Visitors will be continually walking on a sheet of ice, of depth, which will be seen to be inhabited by fish of an antediluvian epoch. The architect entrusted with the construction is M. Auguste Latapy.

Reduction of Magnesia in the Nernst Lamp.

THE source of light in the Nernst lamp, as our readers are aware, is a rod of magnesia, rendered incandescent by the passage of an electric current. Before, however, the current can pass, the resistance of the magnesia must be reduced by heating it from an external source of heat. One of the arrangements for carrying this out was recently noticed in the "Frankfurter Zeitung," and is shown in Fig. 1. The magnesia, A, is placed in the focus of a reflector, C, on the inner side of which is a spiral wire of platinum, D, which, when brought to incandescence by a current, produces heat sufficient to render the magnesia a



FIGS. 1 AND 2.—NERNST LAMP.

conductor. A current is then passed directly through the oxide by the wire, B, and the current in the spiral is shut off. A more complicated form of the lamp is shown in Fig. 2. Here the magnesia, A, is placed within a cylinder, C, which also encloses a platinum spiral, D. As soon as the incandescent spiral has heated the magnesia sufficiently, a current is passed through the oxide by the wire, B. In this circuit is a solenoid, G, which, on being energized, draws down the iron core, E, and lowers the now incandescent magnesia out of the cylinder. When the current is switched off, the pull of the solenoid stops, and a spring, F, raises the iron bar and magnesia to their former positions. Prof. Nernst claims that his lamp gives the same amount of light as the ordinary incandescent at one-third the cost; the light is purer, and no vacuum tube is required.

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The Upper Regions of the Air as Current Conductors.

THERE are a number of striking and important electrical and magnetic phenomena, which though giving rise to speculation and hypotheses, have not yet been explained by generally accepted theories. Among these we may mention the earth's magnetism and electrical storms. A satisfactory explanation of the cause of these phenomena would indeed be a great step in advance on our present knowledge and might indeed lead to results now scarcely within the limits of legitimate speculation.

Undismayed by the numerous and conflicting theories of the past, Prof. W. P. Trowbridge has recently come forward with a new hypothesis which, even if not unassailable in all its details, is nevertheless highly interesting and deserving of more than passing notice. As explained by him in this month's "Forum," if we ascend a sufficient distance the layer of air which surrounds the earth we there find all the conditions requisite for the production of the two phenomena mentioned above, and incidentally a medium which can transmit X-rays. Having in mind the fact that at great altitudes the air is so rarefied as to constitute a good conductor and the further fact that the air absorbs numerous rays emanating from the sun, especially those of short wave length, Prof. Trowbridge asks: Can the disappearance of the short waves of light have anything to do with the production of electrical storms and the appearance of this weird new form of energy? and, Can this disappearance be connected in any way with the production of magnetism of the earth?

Starting with the proposition that the energy involved in the production of these phenomena emanates from the sun primarily, Prof. Trowbridge propounds the further question whether it is not possible that the short waves of energy may in some way produce electrical and magnetic effects in the upper regions of the air, and thus, being transformed, fail to manifest themselves as light at lower altitudes. It is Prof. Trowbridge's main contention that the sun's rays contain the short wave lengths assigned to the X-rays and that, though absorbed by the lower strata of the atmosphere, they exist at the higher altitudes; and that they are instrumental in producing the electricity of the atmosphere and the magnetism of the earth.

Fortifying himself by some recent researches Prof. Trowbridge holds that the solar X-rays give an electrical charge to our atmosphere. The rotation of the earth on its axis would then cause an accumulation of electricity on one side of the earth and a diminution of electricity on the other. We should, therefore, expect a fall of electric pressure between the regions just entering daylight and those in the full glare of the sun. This condition would direct the resulting electric current from east to west, or in the direction opposite to that of the earth's rotation.

The current thus established, according to Prof. Trowbridge, is sufficient to account for the main points of his thesis. The electrical disturbances, such as thunder storms, in the lower regions, might thus be accounted for as being the result of great commotions in the air which constitutes a vast atmospheric sea and due to a local descent of high electrical conditions prevailing in the upper regions. The Northern Lights, again, may, according to the same theory, be due to a dissipation of a portion of the electrical discharge, through layers of rarefied and well conducting air.

Reasoning in an analogous way, the currents existing in the upper well-conducting regions act as a solenoid upon the earth beneath and form the magnetic poles observed. In support of the solenoidal action, Prof. Trowbridge points out that on no other theory could the great distance between the north and south pole be explained; no permanent magnet could have any such length without exhibiting consequent poles. As no currents adequate to produce the poles of the earth have yet been discovered in or on the earth, they may, if they exist, circulate in the upper regions.

This entire reasoning depends of course upon the assumption of the great conductivity of the rarefied, upper regions of the air. This brings Prof. Trowbridge to the question of the practicability of Mr. Tesla's recent proposal to utilize those regions as a conducting medium for the electrical transmission of power. Prof. Trowbridge's experience, based on experiments in the laboratory, lead him to the belief that the method is impracticable. Thus, before one reached the height of ten miles—where there is greatly increased conductivity—the electricity would have deserted the terminal raised to that height and would have flowed to the ground, instead of taking the path of the air to the distant station! In the dark, one can see the reason for the diminished length; for luminous discharges are noted between the high tension apparatus and the floor of the room. The inductive effect is so great that sparks can be drawn from the brick walls and the neighboring gas pipes! The time when the upper regions of the air will be thus used commercially seems therefore to Prof. Trowbridge far distant.

As we have stated above, Prof. Trowbridge's hypothesis is not without objections. Thus, we may ask, how according to that theory, can the fact be accounted for that auroras have been observed within but a hundred yards of the surface of the earth, where there could be no possible adequate rarefaction of the air? Still the hypothesis is interesting and, at least, si non e vero e ben trovato.

Apropos of the suggestion of utilizing the upper strata of the atmosphere as a current conductor, we are reminded by some of our readers of the fact that the idea was put forth some twenty-five years ago by Mr. S. J. M. Bear for telegraph work. And now, Chicago, not to be outdone, has a claimant to the same region, in the person of Mr. Archibald J. Robertson, who claims to have covered the idea in a patent granted to him in 1892. From what he says, it looks as though we shall presently learn of a suit for infringement brought against Mr. Tesla. If a Chicago man can lay claim to giving the main idea of Cyrano de Bergerac to Rostand, why may not another from the same city of unlimited area and ideas claim all the upper atmosphere and its attributes as his own? To avoid strife and the establishment of a grinding monopoly in the future we would suggest that all claims in those regions be now staked and filed in a Government Air Bureau specially organized by Dr. Cleveland Abbe for that purpose, and to be called the Government Rarefied Air Office, with regulations patterned after those of the present Land Office. This might at once mitigate the coming wars with squatters and interlopers.

X-Rays and the "Art Preservative"

THE uses to which the Röntgen rays have already been put have far exceeded the most sanguine expectations of their discoverer, and yet it would be rash to set any definite limit upon what the future may bring forth in the practical application of Prof. Röntgen's wonderful discovery. The great penetrability of the X-rays early suggested to the ever alert mind of Prof. Elihu Thomson that the rays might be employed to advantage as a substitute for, or allied to, our present methods of printing. Thus far nothing tangible has been attempted in this direction; but that the idea possesses more than a germ of life is apparent from the extended article devoted to the subject by Dr. F. S. Kolle elsewhere in these pages. The methods there described of producing a large number of copies of an original

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are all within the bounds of practicability, while the enormous speed of reproduction shown to be possible must command more than passing notice. Although it may be some time before our present mammoth printing presses, the boast of the modern mechanic, may be displaced by the X-ray printing frame, and, while objections of various kinds may be raised to the method viewed from one standpoint or another, there is unquestionably a field for the X-ray printing establishment, which may only require intelligent development to bring it within the domain of the working arts.

An Era of Consolidations.

WHEN Mr. Roswell P. Flower the other day advised young men to quit kicking about trusts, to save money and to get into the trusts, he offered a very excellent piece of advice—in some respects. The point he made was that Russia had been alleged to be seeking a loan in this market, and he preferred the "trusts" as more sure, more profitable. He overlooked the little fact that bankrupt Russia and some of the bloated trusts do not publish any balance sheets that an ordinary mortal can decipher. As a matter of fact, the Russian empire is likely to be here and good for its bonds long after some of the trusts have vanished from sight, and its "securities" may, after all, be the better.

This much being granted, Mr. Flower's wonted keen perception of the drift of things is worthy of attention, and not altogether worthy of dispraise. The word "trust" has somehow been chosen for special application to industrial affairs, just as though scores of railroads had not gone through exactly the same process before, as centripetal "systems," they were rescued from hopeless insolvency and put on a basis of enduring merit. The same law underlies and runs through all things. The United States is but a "trust" of States, and the Anglo-American alliance is but a "trust" of two or more nations.

There is much to be said in favor of unions and trusts; much to be said in favor of individuality, but as long as man is a social being the tendency to get together will be stronger than the tendency to fly apart. Somewhere in the balancing of the opposed tendencies comes the greatest profit for all of us, and the trust is the keenest "point" so far in the field of industrial effort. It is an effort to counteract and offset the grim and disastrous waste of competition, and to just its legitimate value it will be successful. Nature herself requires an enormous and frightful margin of waste; but in the social organism, and in this year of grace, men are chary of superfluity and extravagance. The popular feeling also is that if a man is to save money so that he can go into a trust, it is well that some other trust shall not have crowded him out of his berth and out of his home.

Here comes the issue. The trusts must be subject to the will of the community, but if they follow out a true principle and subserve some real interest of society, not all the legislation of a hundred States will stop them. The need of trusts was recognized when the first laws in favor of corporations went on the statute books, and the mere fact that they multiply is evidence that they have their day, even if in due course of time they cease to be. The great claim is that they economize wealth, effort, brain power, material. In many cases this has shown itself to be so. But wherever a vast aggregation of capital has been rolled up on the base of past effort, and has sought to lay a mortgage on all the future, individuality unduly repressed will evade the burden just as surely as the sun breaks through the mists of its own breeding.

At the present moment the electrical field is peculiarly the arena of consolidations and of trusts. There has been undue competition in many lines, and now comes the inevitable reaction of getting together. This is not at the expense of the public, as so often represented, for where the public has had goods or service below cost, it has got to square the account some time or another, and the trust is often the mere palpable evidence of the indemnification. In the local lighting and street railway field we are glad to note so many unifications, simply because we believe that often in that way can the final, universal supply of current to all consumers alike in any community be attained. In the domain of manufacturing, where wasteful duplication has prevailed, it will presently stop, if not by a "trust" then in some other way; but no actual, necessary appliance or apparatus will be wiped out or its value be lost. On the whole, the greater stability thus attained by the electrical interests as they exist to-day will help the realization of those yet in the offing of possibility. The success of the Western Union was an invitation to push the telephone. The grand industrial success of the telephone was the inducement to thousands to go into electric lighting, and that in turn paved the way for the trolley. These latest two, now becoming the concrete profitable "trusted" investments of which all men speak, are themselves the best advocates for the newer arts that journals like this have ever to fight for on the border line of social advance and technical discovery.

Opportunities in Shanghai.

IT has been known for some time past that the city of Shanghai is about to grant extensive privileges for a trolley system and a telephone service, and now U. S. Consul-General Goodnow furnishes a little additional data that is of interest. He makes the curious commentary that "the Chinese seem very partial to electrical appliances," and also that "they are as curious as children, and will want to discover what there is in the wire to make the car go." This is decidedly contrary to much that has been taught in regard to the Chinese stolid indifference and hostile conservatism in all that concerns modern improvements, and holds out a brighter hope for the Celestial Empire than we have hitherto dared to entertain. No nation that favors electricity and is curious to know why can be regarded as retrogading.

The conditions of the Shanghai tramway concession have been for some time past advertised in our business pages, and do not require, therefore, to be gone into again very fully. There are to be 23 miles of track as a start, with two fares of 10 and 5 cents Mexican, or a little less than half expressed in American money. Both classes of travel should be large. The chief, if not only, competitor is the jinrickisha at a rate of 15 cents Mexican per hour, and it may be remembered that not long ago we printed a poetical lament from Ceylon on the passing away of that queer conveyance before the conquering trolley. The white population will certainly travel in the cars, and the yellow can be educated to do so.

As to the telephone, there is already a service with about 340 subscribers, at a rate of, say, $40 a year, but a 30 years' exclusive franchise is now proposed with purchase option at the end of 15 years. The service is spoken of by Mr. Goodnow as old and poor, and hence it finds a close competitor in the cheap labor, to such an extent that he believes nine-tenths of the messages or "chits" to be carried by coolies at $2.37 gold per month. With a renovated, modernized system things may be different, as they are in Honolulu, where, although the system was old, everybody has had the telephone; and it is likely with the new system that Mr. John Cassidy is installing to become more popular than ever. We cannot bring ourselves to believe for a moment, from our own knowledge of the tropics and coolies, that cheap messengers can compare in any degree with a good telephone system properly operated, and we trust that American apparatus for this as well as for the trolley road may soon be put in for the prosperous city of Shanghai, now growing so rapidly as a European "open door" to China.

A Horseless City.

WHEN such distinguished and antagonistic authorities as Mr. Richard Croker and the New York "Evening Post" agree on any subject, it is pretty sure that their views are sound. Last Saturday the fierce critic of the Tammany chieftain printed an admirable editorial on New York as a horseless city, and on Sunday morning Mr. Croker announced in all the newspapers that the horse had to go because he had taken a hand in the affairs of the Auto-Truck Co. On Monday morning, Mr. Croker gave out an interview in which he paraphrased the "Post," as follows: "The horse as a pet, for pleasure driving or speeding purposes, will always hold a place in the affections of mankind, but for business purposes, the carriage of freight, passengers, and drayage, he must recede before the progress of civilization and the requirements of the present inventive age." For this opinion he advanced several sound reasons, and mentioned the interesting fact that the cartage of coal in New York City every year costs $7,500,000 with horses.

We shall all be deeply interested now in seeing how this compressed air enterprise pans out. So far, such a method of locomotion has failed utterly, but that is not a sufficient reason why there may not be something in this new scheme. The company has a capital stock of $10,000,000 and its stock is being vigorously speculated in on the outside market. We must again confess out rooted preference for electricity, for automobile work in cities, but there is undoubtedly plenty of room for other motive powers, too. Let them all "come on" and be tried.

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TELEPHONY AND TELEGRAPHY

The K R Law in America [1]

THE ELECTRICAL ENGINEER of Oct. 27 contains an article by Mr. A. E. Dobbs on the K R law, in which an example is cited of telephonic communication over a line from Boston to Omaha, the circuit having a K R of 400,000. But as Mr. Dobbs has taken the resistance and capacity of th whole loop instead of that of one line only, as is done in England, the K R of the Boston-Omaha line would be 100,000 according to English practice.

This is still a high value of a K R, and is given as disproving the K R law.

The propounders of the K R law gave a rule where no guide previously existed, and probably they were fully aware that the law would require amplifying or even amending as greater experience was gained. But up to the present no one has succeeded in supplying a better rule.

The article says:

"Lately, however, our English friends have discovered—what we knew long before—namely, that the lines could be cleared of the static charge, by increasing the self-induction and leakage. They place their wires 17 inches apart, while ours do not exceed 12, leaving a larger self-induction factor in our favor. Then our bridging bells, also, increase this factor, and also provide a path for the escape of the static induction between the wires themselves, which may be roughly taken at half the earth induction."

To those English engineers who have had to send men over lines to remove occasional twigs, and even cobwebs to prevent overhearing, it will be news that leakage improves telephonic working.

In England all relays, indicators, etc., have been placed across the loop to remove their inductance from the main circuit. In that position they are a lesser evil, but it would be too much to hope that they facilitate speaking. For if bridging coils afford a path for the static charge, that is, if they cut down the end of a wave, would they not also cut down the beginning of a wave, would they not even cut down the middle of a wave?

It has often been stated that a leaky telegraph wire works better than a sound one, but there is not a single authentic case on record that that is so; while post office records would show a multitude of cases where automatic speed has been reduced owing to low insulation.

The article says: "This balancing the static capacity with the mutual self-induction is a fine art, and building the New York and Chicago line required the best engineering talent of the American Telegraph and Telephone Company to overcome some of the difficulties encountered."

It would be interesting to know how the best engineering talent of America balanced the static capacity with the mutual self-induction, whatever that is.

The article is illustrated with an ordinary mica lightning protector, and it states that, while the protector affords no path to the telephonic currents, "that it offers but very little obstruction against the static discharges, and as every station is equipped with these, it will be seen that the static charge, instead of being increased with the length of the line, becomes materially reduced, so that it amounts to simply that which gathers between stations."

This is certainly a very novel theory. It has hitherto been thought that a static charge cannot have a greater e. m. f. than the current that produces it.

The Americans are not the only people who confound static capacity with static charge, and something similar to the following may be found in English prints: "Another factor in reducing the static capacity, is that of having regular leaks to ground, with a resistance high enough to prevent any appreciable loss of current." No doubt we shall soon all know that electrostatic capacity depends upon the dimensions and positions of conductors only, and upon no other thing. The static capacity is no more reduced by a leak than is a pint measure made less than a pint by having a hole in it.

[1] London Electrical Review.

A Reply from Mr. Dobbs.

BY A. E. DOBBS.

I ADMIRE English engineering methods as a rule, but sometimes like the German who had never seen an elephant, but constructed a picture of one from his own "inner consciousness," people are apt to make mistakes, and then imagine they cannot be wrong.

Now, no one disputes the effects of the K R law in laboratory tests, but laboratory tests and cross-country tests are apt to differ in results. It may be that instruments are made which will talk over a higher K R resistance than 50,000, and it may be that the effects of capacity, distributed over 2,000 miles of line, are different from those obtained across the terminals of a condenser. It may even happen that the line resistance interferes with the capacity effects. But how does our brother get that K R of 100,000 on the Boston-Omaha line. Webb, in his telephone hand book, and he is in a position to know, states that this capacity is about .015 mf per mile—that is, to earth. Now, as this line is about 2,000 miles long (we have one still longer), and the copper averages about 2 ohms to the mile, we have for one side $2,000 \times 0.15 = 30$ mf. $30 \times 4,000$ ohms $= 12,000$, to which must be added the ohmic resistance of the other side of the line.

Now, this value is still more than twice the value of the K R law. That is a fact that no amount of theorizing can explain away.

"It will be news that leakage improves telephonic working." It is no news to operators or linemen in this country, and it has come under my own personal observation so many times that MODERATE leakage improves both telegraphic and telephonic working that it is hardly worth while to discuss it except to ask: "What is the meaning of certain patents issued to Lord Kelvin on this very subject?" It would also be well to remember that climatic conditions in the British isles are very different from the dry and highly electrified atmosphere of this country, and automatic telegraph working is very different from telephonic working, and the two must not be confused, for that very confusion of ideas once led an eminent English electrician to predict commercial failure for the telephone.

As to mutual self-induction, which our friends find a stumbling block, a full description of it can be found in a little book by Fleming on "Alternating Current Phenomena," price 4s. 2d., and sold by the publishers of this paper.

I need only add that some telephone, and telegraph engineers, too, have added to the self-induction of their lines by using copper wire with a steel core and gaining the requisite conductivity by using wire a size larger, and that while it does WEAKEN the voltage of the lines, the effect is a clearer transmission, as fully explained in my article in the Engineer of Oct. 27. A repeater, for example, reduces the VOLUME of sound, but many lines could not be worked without it. As to the difference between static capacity and the static charge it looks to me like a theological argument on baptism, and as the effect of the static current, irrespective of what you call it, is detrimental to telephonic working, we have it to deal with in our calculations.

But, seriously, there are some problems connected with telephone engineering that are not yet solved, but American engineers will have a great many more of them formulated within the next five years.

Now, I would suggest as a partial solution of the difficulty the following, not as a rule to go by, but merely as a guess, that the static capacity to earth on a metallic circuit has been overcome by transpositions and other devices, and that only that between the wires is to be dealt with. This would reduce the K R of a 2,000 mile to about 52,000, which may help solve the difficulty.

Features of Chinese Telegraphy.

In an article in the "Engineering Magazine" on "Industrial Progress in China," by J. S. Fearon and E. P. Allen, these interesting statements are made: "The telegraph is the only institution of modern science which has obtained any considerable foothold in China. Peking is connected by wire with Tientsin and with Manchurian points up to the Russian frontier, whence connection is continued by Russian-Siberian lines to Europe. The capital is also connected with all the treaty ports and principal cities in China proper, and these again with each other. Canton has connection also through Yünnan with Burma. China learned the value of the telegraph in the war with France, and it has long since been admitted to have 'become indispensable.' The telegraph, however, is under Imperial

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control, and there is probably little opportunity for its extension as a private enterprise. Chinese writing being not alphabetic, but syllabic, and there being as many characters as there are words in use, the telegraphic messages are sent in a number cipher. For transcribing messages received a double-ended type is used; on one end is the character, and on the other the corresponding number. When a message is received, it is set up by the number, and then printed from the reverse, or character, end."

Keating Telephone Selective System.

BY A. S. KEATING.

SOME time ago I thought out a novel telephone selective system. Thinking you might like to use it as a matter of news to your many telephone readers, I herewith send you a description of it. The device not only serves as an individual call system, but as a means of keeping correct time in the office, and as a time limit to the use of telephone by subscribers.

The device is to be used on party lines of five subscribers. It consists simply of an ordinary small clock set on a shelf on the magneto box directly under the bells in front. The clock is provided with a vulcanite flat ring having twelve small round pieces set in the face of the ring. The pieces extend through the ring and are all connected together at the back by means of a wire or other metal connection. The pieces are divided equally apart around the ring so as to make twelve points corresponding to numbers of hours on face of clock, and are only in width about the length of a minute space on the dial of the clock. The pieces are flush with the vulcanite ring on the face. The ring in diameter is about the diameter of the clock dial, and is ¼ or ⅜-inch wide. When set on the face or dial of the clock, it can be moved around so as to bring the metal pieces directly over some one of the minute spaces on the dial. To illustrate: I will turn the vulcanite ring so that one of the metal pieces or points is directly over one minute after twelve. This brings each metal piece in the vulcanite ring directly over the first minute after each hour mark clear around the clock. Subscriber No. 2 has his ring turned to the second minute, subscriber No. 3 to the third minute, subscriber No. 4 to the fourth minute, and subscriber No. 5 to the fifth minute. In a bridging bell, the wire from the line is made fast to the wire on the back of the vulcanite ring connecting the metal pieces together. The second wire from the line after passing through the bells is made fast to the body of the clock. The vulcanite ring is insulated from the clock body. To complete the circuit through bells, the minute hand on the clock must be on some one of the metal points on the vulcanite ring. To illustrate: Subscriber No. 1 looks at his clock and sees that the hour hand is on the third minute. He knows that subscriber No. 3's bells are in circuit, and if he is the man he wants, he simply pushes in on the handle of his magneto connecting his generator to line and rings him up. Subscriber No. 1's bells will not ring, as they are out of circuit. Of the five subscribers on the line, their bells are in circuit one minute during each five minutes, or twelve times an hour. It will be noted that although the line is a party of five, only one magneto bell is in circuit at a time. Two subscribers talking hold the line. Central is always in circuit, as it is not provided with a clock arrangement, and can be called any time by the subscriber pushing in on handle connecting his generator to line.

For series circuits, a metal ring provided with vulcanite pieces or points is substituted for the vulcanite one. The metal ring shunts the bells when the minute hand of the clock rests on the ring. While the minute hand is passing over the vulcanite piece or point in the ring, the bell is in circuit, as the shunt is open. In this there is only one magneto in circuit at any time; consequently the resistance of only one bell in a series system of five.

The clocks are kept in correct time by daily report to central. A subscriber's bell only rings when he is wanted. A subscriber can be called only once in every five minutes, giving others on the line a chance.

Telephones for Farmers.

Representative Merrill, of Sedgwick, has introduced a bill in the Kansas House of Representatives providing for county ownership of telephones. It is a very socialistic measure, and provides that upon a petition signed by 5 per cent. of the voters of a county the question "Shall the county own its telephone system?" shall be submitted to a vote of the people at the general election. If the proposition carries, then the county shall build a system and supply every farm house with a telephone. The expense of building and operating the plant is to be borne by direct taxation, and the county is given authority to spread out the original cost of construction over ten years, one-tenth to be paid each year. The same bill also provides for intercounty ownership.

Bell Telephone in Illinois.

A special dispatch of Jan. 1, from Tuscola, Ill., says: The Bell Telephone Company has just succeeded in absorbing the Interstate Telephone Company, which had headquarters in this city. The Interstate Company owned and operated several hundred miles of lines in Central Illinois, and as the Bell Company threatened to cover the same territory, a compromise was effected whereby the Interstate goes out of existence.

Indicting the Western Union.

The Camden (N. J.) Grand Jury has indicted the Western Union Telegraph Co. for complicity with "green goods" swindlers and "policy" gamblers, on the ground of the co-operation of local manager Bertholf, who is indicted individually.

Independent Telephony in New York City.

The New York City Council's Committee on Streets and Highways gave a hearing last week on the resolution introduced by Councilman Murray imposing a rental of $10 a year for each pole erected in the city by telephone companies. A. H. Mildenberg, general manager of the People's Telephone Company, spoke in opposition to the ordinance, which he said would work an injustice to his company. Previous to consolidation the New York and New Jersey Telephone Company obtained the right to use the poles erected for the use of the Police and Fire Departments in Brooklyn. In this city the same interests control the conduit system, and ask $800 a year rent for the use of one mile of streets. If this ordinance were passed Mr. Mildenberg explained, his company would be compelled to pay exorbitant rentals to its rival or go out of business.

It was decided to ask the Corporation Counsel for an opinion as to whether or not the contract between the city and the New York and New Jersey Telephone Company could be annulled.

Bell Telephone Financial Schemes.

A special despatch from Boston of January 13 says: It is reported that the American Bell Telephone Company may move its corporate home to New York, on the ground that the laws of Massachusetts applied to corporations are too restrictive. The Bell Company, it is said, on deciding to expand on both a share capital and a bond basis, may resort to the laws of New Jersey. The llaws of Massachusetts provide that no corporation shall contract an indebtedness beyond 50 per cent. of the par value of the stock. The present capital is $25,000,000 or $30,000,000. The company may issue on that only $12,500,000 or $15,000,000 in bonds, although the stock, selling at $290 a share, as recently quoted, is valued at $75,000,000. Neither confirmation nor denial of the report can be obtained from Bell Company officials in Boston.

The Growth of Erie Bell Telephone.

A special dispatch from Boston says: The Erie Telephone Co., by the absorption of the Michigan Telephone Co., becomes the largest operating telephone company in the United States. The four leading companies, however, are so near together that there will probably be a great race the next few years for the head of the list in the number of telephone subscribers. It seems a bit singular the New England Telephone Co., the home of the telephone, should rank fourth with 40,000 subscribers, while the Pacific Coast Co., has 45,000 subscribers. The Erie system with its present 50,000 subscribers, including Michigan, will probably be raced very strongly by the Pacific Coast Co.

The Erie system, including Michigan, gained 10,000, and the Pacific Coast Co. 10,500 last year. General Sabin, of the Pacific Coast Co., has hung a card in his office as the motto and aim of the company: "Pacific coast States, 100,000 subscribers." In 1895 General Sabin was presented with a diamond pin to mark the epoch of 10,000 subscribers in San Francisco, which was twice the number that had been considered the limit a few years previously.

The subject of increasing the Erie Telephone Co.'s dividend

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is now under discussion. Since the company has been paying 4 per cent. per annum the growth of the same territory has been 50 per cent. The company is now earning 6 per cent., and it is argued that it has now reached the stage where it should pay what it earns.

Telegraph to the Klondike.

There is every indication of a keen fight between the two rival telegraph companies negotiating for the construction of a telegraph line to the Klondike. They are the Canadian and British Columbian and Dawson City Telegraph Company, and the Northern Commercial Telegraph Company. Two letters have been received at Vancouver from Hon. A. G. Blair, Minister of Railways and Canals, in which he states that the government is extremely anxious that the work shall be taken up by private enterprise and pushed.

GREAT NORTHERN RY. It is reported from Crookston, Minn., that Superintendent of Telegraph C. P. Adams and local manager W. W. Hall have been working on experiments to use the telegraph wires for telephone purposes over a single line and earth return. Fair success is said to have been attained.

New Central Telephone Exchange, Paris.

THERE has been of late a rapid growth in the telephone system of Paris, and that city has now it is said some 18,000 subscribers. These are of course divided up into various exchanges, but of late, we are informed, a new main board has been built with a total capacity of not less than 10,000 subscribers, and a new central building has become necessary, as in Brussels, the new central of which we illustrated last week.

In Paris, the new building, for views of which we are indebted to "Heating and Ventilation," has been designed by M. Brussard, architect of the Postal and Telegraph Department, and has been erected on the Rue Gutemberg opposite the Postal and Telegraph governmental headquarters, so that facilities for the convenience of the administration are of a superior character. The exchange consists of a main building, as shown, on the Rue Gutemberg, with a wing extending to the rear, for the officials. The ground occupied is of peculiar shape, but the architect has ingeniously secured its full advantages in providing a clear run right through, for the operating floor, from the Rue du Louvre to the Rue Jean Jacques Rousseau, on which the offices are situated.

THE NEW CENTRAL TELEPHONE EXCHANGE, PARIS, FRANCE.

The front of the building is very striking architecturally, hav-

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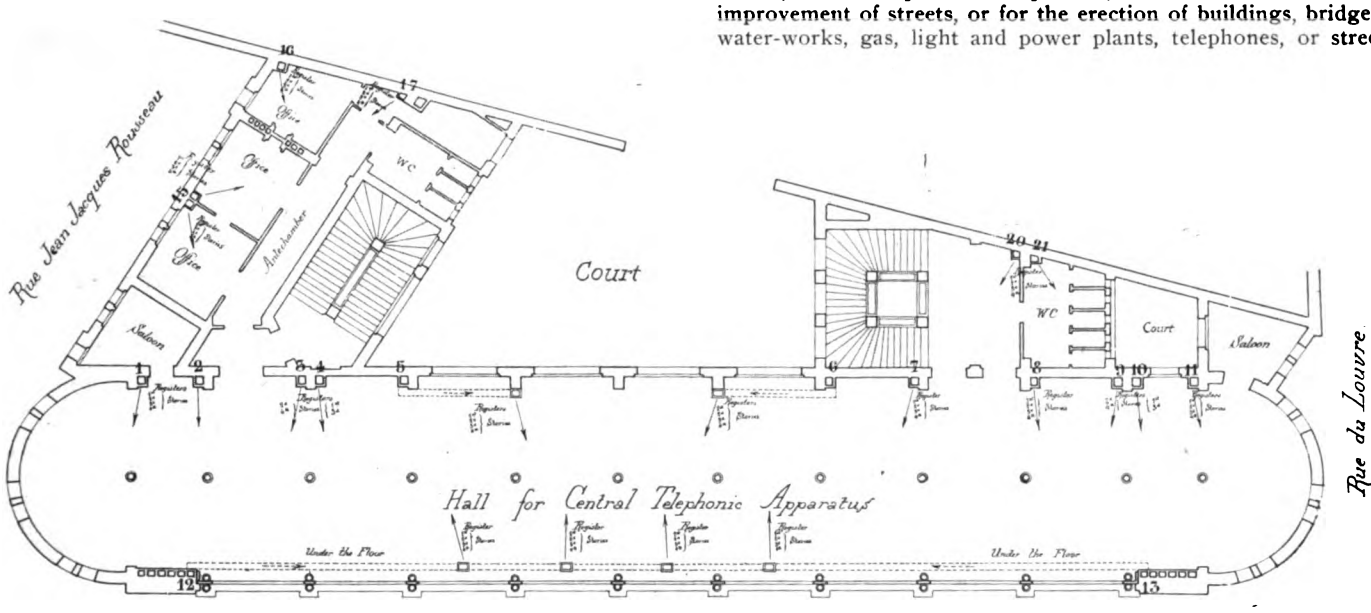
ing a ceramic surface, done largely in blue enameled tiles with terra cotta ornamentation. The methods of illumination and ventilating are modern in every way. The system of ventilation is the same as at Brussels, using the Anthonay "auto-calorifere,"



PLAN OF OPERATING FLOOR, PARIS TELEPHONE EXCHANGE.

with a fan, and is operated in both summer and winter. Provision is made on the ground floor on the Rue du Louvre for the public, a number of booths being equipped there for general use.

MUNICIPAL AFFAIRS

Wyandotte, Mich., Municipal Plant to be Investigated.

With three or four little old oil lamps shedding an uncertain light on the scene, the Wyandotte city fathers one night last week discussed the electric light situation, and decided that matters must be remedied at once. Charges were freely made against members of the board of public works and the employees of the lighting plant, and, after a thorough discussion of the subject, Mayor Gartner appointed a committee of three to hold an investigation. Mayor Gartner had sent in a communication on the subject. He stated that "in view of the several accidents which have occurred to the public lighting plant of the city of Wyandotte in the last few months, together with the allegations and charges made by numerous citizens as to extravagance, incompetence and flagrant neglect" on the part of employees of the board, he deemed it wise to have the council institute an investigation, and hire a mechanical and electrical engineer to give expert testimony. The mayor stated that during the past week he had hardly been able to attend to business, so many complaints had been made to him.

Kansas Cities to Acquire Any Old Thing.

In the Kansas House of Representatives Mr. Rutledge has introduced a bill, by request, giving cities of the first class the right to acquire and maintain public parks, street railways, electric plants, water-works, telephones, gas plants and all other kind of public utilities. The main provision of the bill reads:

"Private property and the property of any person, co-partnership, company, or corporation using the streets, alleys or grounds of the city, may be purchased, condemned or appropriated for the use of the city for parks, streets, alleys, levees or market places, depot grounds, bridges, or for the purpose of operating, managing and conducting a system of water-works, gas plants, light and power plants, street railways, telephone service, or other public utility by the city or to enlarge and widen streets, and to acquire stone quarries, or other material for the improvement of streets, or for the erection of buildings, bridges, water-works, gas, light and power plants, telephones, or street railways. That the proceedings to condemn property for the purposes stated shall be in the manner now prescribed by law."

Opposition to Municipal Plant at Williamsport, Md.

The question of the town of Williamsport issuing $20,000 in bonds to construct waterworks and an electric light plant has caused a great division of opinion. Strong opposition to the plan exists among the people, who think the municipal tax rate will be forced up from 30 cents to $1. Those favorable to the improvements have issued a public statement, in which they endeavor to prove that the town will clear over $1,000—profits from waterworks and lighting plant—and that the tax rate will remain the same as at present. Several members of the commission appointed by Burgess Thompson to construct these public works hesitate to accept. The Hagerstown Railway Company has offered to sell to the town for $6,000 the old power house, containing two 150-horse power boilers, which the company will abandon shortly, having built a new and larger one in Hagerstown.

PERSONAL

MR. JOHN E. BORNE, president of the Colonial Trust Co., has been elected president of the Nassau trolley system, Brooklyn, in place of A. L. Johnson, whose brother, Tom L. Johnson, is succeeded by Hugh J. Grant as vice-president. Mr. C. D. Meneely, who is auditor of the Brooklyn Rapid Transit Co., becomes treasurer. Mr. W. F. Ham remains as secretary.

MR. J. G. WHITE, of the well known electrical engineering firm that bears his name, returned home last week on the "St. Paul" after a stormy and prolonged trip, the steamer springing a crack in one of her main steam pipes, which necessitated lowering the pressure.

COL. JOHN N. PARTRIDGE, well known in Brooklyn trolley enterprises, has been selected by Gov. Roosevelt as superintendent of Public Works of this State. The choice is an admirable one and will doubtless be confirmed.

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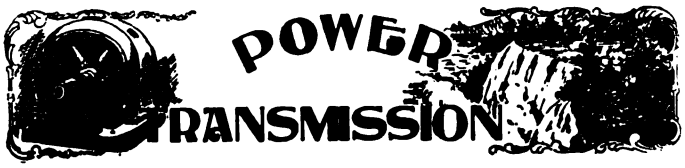

Drury Lane Stage, London, Operated by Electricity.

THE swift conquest of the modern stage by electricity in the form of light and power and for spectacular effect has received its latest and one of its most interesting exemplifications at Drury Lane, London. The stage there is one of the largest in the world, and the application of electricity to its mechanism offered difficulties of no mean order. It will now be seen that

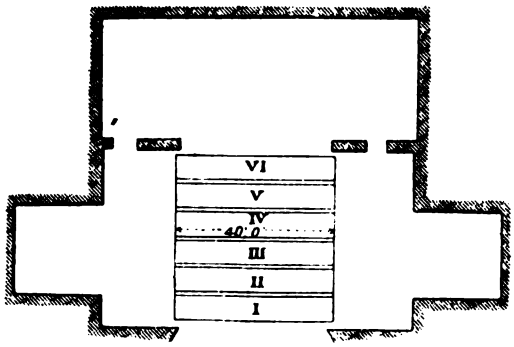

FIG. 1. PLAN OF DRURY LANE STAGE AS DISSECTED.

by dividing that huge stage up into six sections a system of complete flexibility and movability has been obtained, with the aid of electric motors, as illustrated in the accompanying engravings, the work having been done by Mr. Edwin O. Sachs, upon the initiative of Mr. Arthur Collins, of the Theatre Royal, Drury Lane. Mr. Sachs, who was called in by the management to design the installation, divided up the main stage into six sections (Fig. 1), the whole of which are to be moved vertically either 12 ft. above the stage level, or 8 ft. below it., and while the fifth and sixth sections were to be able to move vertically only (being the most distant from the audience) and only to move as a whole; the third and fourth were also to move in a sloping direction, while the first and second sections, besides allowing for the sloping movement, were also to be cut up into numerous small subsections for "traps" and the like. For the third and fourth sections, the hydraulic "bridges" are retained for the present. In arranging the six main divisions, each of equal dimensions, i. e., 40 feet by 6 feet 9 inches, with an 8-inch "flap" intervening, Mr. Sachs was guided by the possibility of a future adaptation of the "turn-table" principle, which has been experimentally tried at Munich. In that case the six sections will practically only have to be lowered a few feet to take the necessary tramlines for the rolling-way, and the "turn-table" will also be installed by sec-

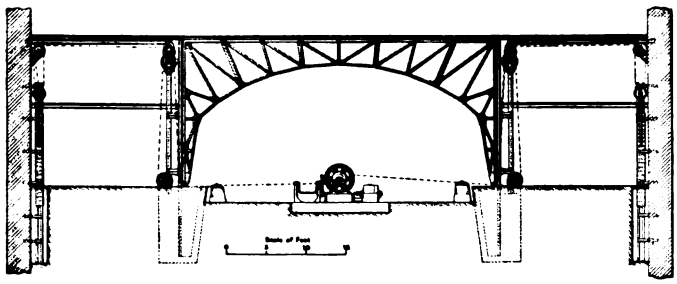

FIG. 2.—PLAN OF ELECTRICAL OPERATION, DRURY LANE STAGE.

tions, with its centre pivot between the third and fourth sections. Meantime, two sections have been equipped with electric power, as indicated in Fig. 2, while these sections are shown in use in Fig. 3.

It will be seen that the actual platform or section of stage flooring is carried by two light steel arched lattice girders of simple but substantial design, well braced together to form a rigid structure, the lattice girders measuring 38 feet 10 inches over all. The steel portion of each lift weighs a little over 4¾ tons. The platforms themselves weigh 1½ tons more, so that the total dead weight may be considered to weigh between 6 and 6½ tons. Each lift frame and platform is counterbalanced to the extent of about 4½ tons, the counterweights being taken on a double purchase to the side walls of the stage proper, and hanging from cables placed centrally. The mechanism which elevates that part of the lift which is not counterweighted, together with its live load, is placed entirely below, and comprises in each case an independent electric motor with drums and cables. The power is supplied from the ordinary street mains to a four-pole enclosed type motor which develops 7½ horse power at 520 revolutions per minute, but is capable of working at higher rates on an emergency. The speed is reduced in a ratio of 104 to 1, through a large wormwheel, this wormwheel being geared to a shaft which carries two winding drums, making five revolutions per minute. Upon these drums are wound the steel wire ropes which pass over guide pulleys, and are connected to the legs at all four corners. The speed obtained by working these cables is 16 feet per minute, but it could be reduced by half with the use of resistances. In order to equalize the tension on the ropes, some compensating arrangements have been made, and are shown in the drawings, the lift in each case being practically balanced, but the position of this compensating gear must be considered temporary, as in its present location it interferes with the approach to the lift when at its lower level. As regards the control of the motor, there is a combined starting and reversing

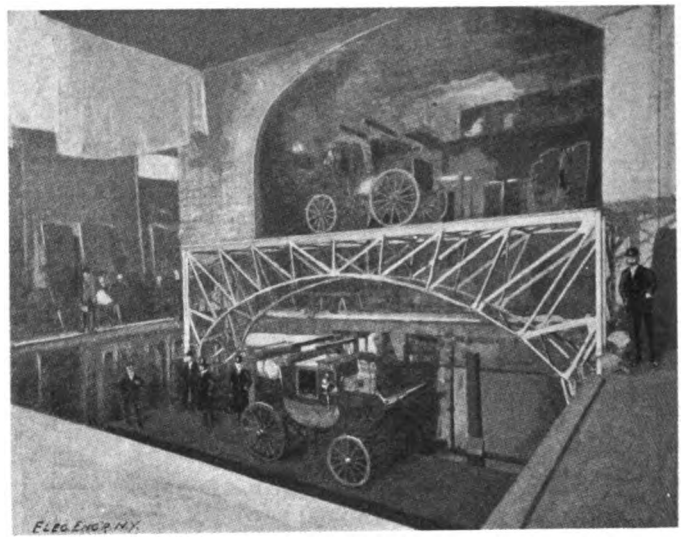

FIG. 3. DRURY LANE STAGE, OPERATED ELECTRICALLY.

switch. Automatic cut-outs are provided, and automatic switches to cut off the current at the right place. In order to meet the emergency of the current giving out, hand-gear has been provided by the application of a crab arrangement to the worm-shaft opposite the motor, and this is so contrived that the operation of change from motor to hand, or vice versa, only takes a few seconds. In the event of the breakage of one of the ropes, safety catches have also been provided, and certain gear has been installed, so as to make the "bridges" absolutely stationary at certain fixed points.

As regards the load the shifts can take up beyond their own unbalanced dead weight Fig. 3 showing two of the lifts loaded with road coaches, gives some idea of the live load possible, but taken generally these lifts are not intended to be used by more than thirty people and the usual scenery at any one time.

The bridge structures were furnished by the Thames Iron Works, and Shipbuilding Company, Ltd., of London, whose electrical engineer, Mr. Grove, designed the whole electrical system, including the motors.

CREED ELECTRIC HEATER CO. has been formed with a capital stock of $125,000, of which $30,000 has been subscribed and $300 paid in. The incorporators are W. K. Lazee, W. D. Flagg, Providence, R. I., and P. T. Creed, of Taunton, Mass.

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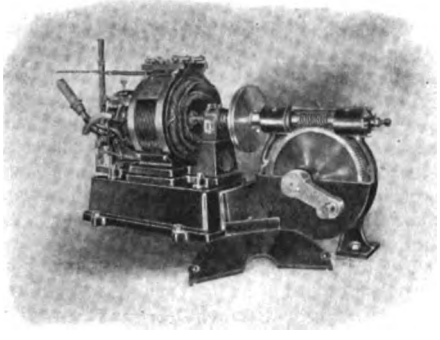
Emerson Single Phase Motor and Organ Blowing Outfit.

THE application of electric power to church organ blowing and kindred work has been an interesting field, calling for the exercise of considerable ingenuity to meet the various requirements of regularity, compactness, economy, safety, etc. We illustrate herewith a mechanism of admirable arrangement devised and now being introduced by the Emerson Electric Mfg. Co., of St. Louis. It is their pumping outfit, No. 200, with automatic clutch and connection to organ bellows, by means of which the pumping mechanism of a pipe organ is automatically regulated to supply the amount of air required. Of course, the same general principles would apply with any type of current, but in the present instance the motor shown is an Emerson single-phase of 1 h. p. It has triple worm gear, converting the rotary motion of the motor at 1,800 revs. per minute into the 45 strokes per minute reciprocal crank movement of the organ pump.

In this system the motor is started and left running, at a constant speed, while the organ is in use, and would be left running during an entire service or concert. The only disadvantage to this is the amount of current used while the pump is not in operation, and as this amounts to only 1 3-10 cents per hour on a 1 h. p. motor with a rate of 10 cents per kilowatt (power rates range from 5 to 20 cents per kilowatt for this class of work) it will be seen it is a negligible factor, and in fact fully compensated for by the absence of extra current in starting several times.

The advantages claimed for this system are quite numerous, the principal ones being the absence of regulating rheostats and



EMERSON ORGAN PUMPING OUTFIT.

sparking of contacts on stopping and starting, while the simplicity and compactness of the outfit speaks for itself.

The operation of this outfit is as follows: The motor is started by the handle marked "Motor Starting Handle," and as the bellows of the organ are presumably empty, the friction clutch shown at the other end of the motor shaft is in contact with the worm disc, and the motor begins pumping air into the air reservoir until filled. The natural rise of the top of the air reservoir to which a chain marked "Connection to Bellows" is attached through pulleys or bell-cranks releases the friction disc when the bellows are filled to any desired point, and the pump mechanism will stop, leaving the motor running free, and thus taking almost no current. As soon as the air reservoir begins to empty, this allows the clutch to operate again and to supply as much or as little air as may be necessary to keep the reservoir full or well supplied with air.

The action of the friction discs is positive and noiseless. The worm is of hardened steel. The worm wheel is run in a bath of oil, and is, therefore, perfectly lubricated at all times, and the entire outfit is designed and manufactured in a thoroughly first-class and workmanlike manner to stand hard and continuous service with little or no attention. The action of the outfit may be controlled so as to pump fast or slow, and to change speed as the air reservoir fills by merely making a spring connection between air reservoir and motor instead of solid connection, but the Emerson Co. advise the latter whenever practicable, as there is then very little or no wear on the friction clutch.

SCRANTON, PA. Mr. T. C. Melvin one of the Councilmen, is moving to have a special election on a bond issue to provide money for a municipal plant.

MISCELLANEOUS

A Chapter on Electrical Diction.

BY HARRY L. TYLER.

NOTHING hinders the layman more than do some of the words that have been elbowed into electrical diction. Terms and phrases that are altogether inconsistent have arisen through the misuse of the word electricity, which is brought into play much too frequently by people that strive to make up in clatter what they lack in matter. Those that deal with electrification as with a substance require peculiar phraseology to describe its transportation—and they have much to choose from; still, with electricity rightly defined, this phraseology loses its parentage.

What is electricity? It is the science that treats of electrification—and an electrifying machine is not a generator of that science. We have electric generators; but generators of electricity—never. Regardless of how some dictionaries define the word the fact remains that it can not consistently be used as the name of a substance. One can study electricity (electrical science), but one can not pass a current of electricity through a thing any sooner than one can cause a current of mechanical engineering to flow through it. It would be absurd to speak of pouring chemistry (the science that treats of the composition of substances) through a funnel that one pours chemicals through. Yet people speak of pushing a current of electricity (the science that treats of electrification) through wires at the instant of electrification. Electric appliances are worked by electrification—not by electricity.

"Writers are often unduly afraid of repeating the same word, and require to be reminded that it is always better to use the right word over again than to replace it with a wrong one—and a word that is liable to be misunderstood is a wrong one."—Hall.

Among the words that are made to do duty for the right word ohmage are: resistance; hindrance. The word resistance is perhaps the less offensive, but after all it is too broad for electrical use. The instant resistance is mentioned, even the advanced student associates it with the conveyance of something, which is wrong. The dictionaries misrepresent ohmage by calling it resistance, which they define as "a certain hindrance or opposition to the passage of an electrical current or discharge offered by conducting bodies!" Do so-called non-conducting bodies have no ohmage? From other points of view such a definition is funny to people that know the truth. How can there be a hindrance to the passage of something that does not pass—namely, an electrical current?

Among the words that are used in place of the better word voltage are: electromotive force; potential difference; pressure; tension.

Where amperage should be used one frequently finds: current; electricity; electric current; quantity; rate of flow; electric fluid.

"An electrician accidentally brought his back in contact with the positive and negative keys of an arc line, carrying 4,000 volts of electricity. He withstood 4,000 volts, as all the arc lights were extinguished for the time."

The foregoing description of an accident that occurred in New Albany, Ind., appeared in several newspapers, in some medical publications and was reprinted without correction in a leading electrical journal. Volts of electricity! What are they? Anyone that is familiar with an arc circuit knows that if the circuit was a 10-ampere circuit the man's back was electrified 10 amperes by an unknown voltage. Certainly the fact that the lights were extinguished is no indication that the man withstood 4,000 volts. In maintaining a constant amperage, the regulator of the generator lowered the voltage the instant the man's back short-circuited the poles. It is very likely that the voltage of the poles was not more than 400 during the accident. It is not to be wondered at that people, after reading that "500 volts of electricity mean certain death," are puzzled when they learn from the same publication that a man lives after having "4000 volts of electricity passed through his body!" As far as electrical units are concerned, the following tells all that is known about the accident: "An electrician accidentally contacted the poles of a 10 ampere arc generator with his back. The voltage of the poles was 4,000 before the accident."

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"The man hung in mid-air and 1,750 volts of the deadly electricity passed through his veins. It has been learned that during the accident 12 amperes of current were turned into his body."—Daily newspaper.

Volts of electricity again. Is electrical science deadly? Can amperes be turned into anything? The writer had done better had he written: "The man was electrified 12 amperes by 1,750 volts."

From an electrical point of view the word current is superfluous, if not expressive of something entirely wrong, and it never should be used in an electrical sense. Yet it is rare that one reads an electrical article without encountering it in almost every paragraph, and an electrical advertisement without current before its nouns is something never found. After a little thought, however, it becomes clear that a forcible statement becomes forcible-feeble when current is not suppressed.

There are neither alternating currents nor direct currents. Besides, direct is not opposed to alternating. Continuous is the proper word. There are alternating and continuous circuits, i. e., circuits whose polarity is alternating or continuous, as the case may be.

"The generators are of the alternating current type." Suppress current.

"A direct-current motor was installed." Even if there were a current, would it ever be indirect? The writer undoubtedly meant: "A continuous motor was installed," i. e., a motor designed to operate in a circuit of continuous polarity.

"The lamp draws a current of six amperes." Rightly: "The lamp is electrified six amperes," or "the amperage of the lamp is six."

"The alternating current is more painful than the continuous current." Better: "Alternating electrification is more painful than continuous electrification."

"The High Tension Storage Company." Rightly: "The High Voltage Storage Company."

"The current will be conducted at 1,000 volts from the generators to the transformers." Should be: "Circuits of 1,000 volts will connect the generators to the transformers."

"The switchboard was designed to handle the current from five of the machines." Better: "The switchboard was designed for the amperage of five of the generators."

"It (the multiphase cable) consists of a copper conductor,' etc. Why say a copper conductor? Are there any non-conductors, and, above all, are there copper non-conductors? Better: "It consists of a copper wire," etc.

"The Buffalo Railway Company is now taking 2,000 horse power of the Niagara current." Did the writer mean 2,000 horse power of the Niagara water current? If not, he should have written: "2,000 horse power from the Niagara generators."

Although they are much too plain for lovers of the strange and high-sounding, the little words ohmage, voltage and amperage, are all that one needs in stating any common electrical fact, and they lose nothing by repetition. Not one of the words frequently found instead has a shadow of defense for its use. The employment of such substitutes should be left for people that strive to be fine; people whose prepossession for extravagance is greater than their regard for conformity. By all means let us give Ohm, Volta and Ampere their due by using the words made in their honor.

Influence of Induction Coil Condensers on X-Ray Definition.

BY ALFRED G. DELL.

IN making experiments to determine the effects on X-rays by varying the capacity of an adjustable condenser connected across the breaks of the interrupters of induction coils, I was impressed with the possibility that the varying penetrability of the light obtained by various experimenters in the fluoroscopes used was, if not entirely, at least to a considerable extent to be attributed to the different capacities of the condensers used.

The different penetrabilities of the rays have been ascribed to the vacuum of the tubes. While the vacuum of particular tubes may have some little to do with the penetrability of the X-rays produced, I think the capacity of the condenser plays a more important part than is generally supposed.

I find the light obtained in a fluoroscope, when the capacity of the condenser is between certain limits, is clearer, and objects are more distinct. The light is not such as would be obtained by increasing the electromotive force in the primary of the coil with capacities outside of the limits. The light obtained, no matter what the electromotive force used, when the capacity of the condenser is outside of the favorable limits, is more cloudy or duller in color, than when within the favorable limits.

The same proper capacity for the same coil seems to suit a rather wide range of electromotive forces in the primary of the coil, from which I would conclude that the proper capacity for any particular coil could be fixed in value, but, of course, an adjustable condenser is better.

I also find there is a limit to the electromotive force to be used with any particular coil, beyond which it is not well to go, when a good definition in the fluoroscope is required. One can obtain more light with excessive electromotive force, but poorer definition of the object.

I believe the cause of the better light between certain capacities of the condenser is that the impulses are made with greater suddenness, and the cathode discharges falling on the anode with greater vigor produce a clearer light. Each impulse is produced in less time with the proper capacity than when the capacity of the condenser is not right.

When the capacity is too small or too great, the impulses are more prolonged in their discharge, and the cathode discharges striking the anode plate fall on it more in a stream, as it were, and produce the cloudy light, and not the extreme bright light obtained with a proper condenser capacity. I really do not see why the fluoroscope could not take the place of the photographic plate, if attention is paid to small, but important, details in construction and use of the apparatus in cases where a record is not absolutely required.

Electricity from Peat.

"Stahl und Eisen" contains an article in which the author Dr. Frank, proposes to utilize the great peat beds of North Germany for the production of electricity on a large scale. He estimates that a hectare of turf, three metres thick, gives 2,500 tons of dry turf, equivalent to 1,200 tons of coke, or in English measure, an acre of turf, 10 feet thick, gives a 1,000 tons of dry turf, equivalent to 480 tons of coke. The mosses of the Evus valley, which cover an area of 1,000 square miles, might furnish the equivalent 300,000,000 tons of pit coal; that is to say, more than the total production of Germany for three years. The turf would be burnt at central stations of 10,000 horse power capacity, consuming annually 200,000 tons of turf, the product of 200 acres of the beds. One application of the power produced would be to the service of the canal connecting Dortmund to the Evus, which will soon be finished; but the author thinks the most interesting will be the manufacture of acetylene, the materials for which can be obtained easily and cheaply in the neighborhood. With 10,000 horse power, a quantity of acetylene can be produced daily equivalent for lighting purposes to 150,000 gallons of petroleum, or annually in value to 20,000 tons of foreign imported petroleum.

Electrifying Havana.

A Havana, Cuba, cable despatch of January 13 says: Colonel G. B. M. Harvey, of the Havana Electric Railway Company, which has bought up the old street railway company, left to-day for New York, accompanied by Hallet Allsop Borrowe, who will probably be general manager of the new line. Borrowe, who handled the dynamite gun at Santiago, says that Cuba possesses a fascination for him that no other part of the world does.

The Havana company proposes to operate all the electric lighting plants and street railways of both Santiago and Havana. General Ludlow issued orders to-day allowing the company to relay the rails and install an electric system. Percival Farquhar, the company's representative, said to-day: "The new equipment will be as good as any in New York. Modern open trolley cars will take the place of the old horse cars, and the lines will be extended to Cerro and Marianao."

Mr. W. M. McFarland.

Chief Engineer Walter M. McFarland, lately chief assistant to Commodore George W. Melville, Engineer-in-Chief of the Bureau of Steam Engineering of the United States Navy, has entered upon his new duties as assistant to B. H. Warren, vice-president and general manager of the Westinghouse Electric and Manufacturing Company.

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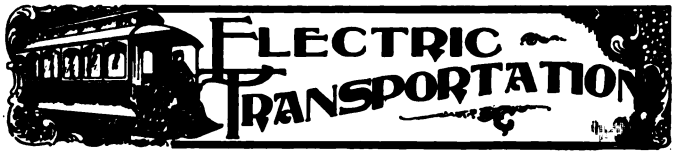
Cost of Electrolytic Copper Refining.

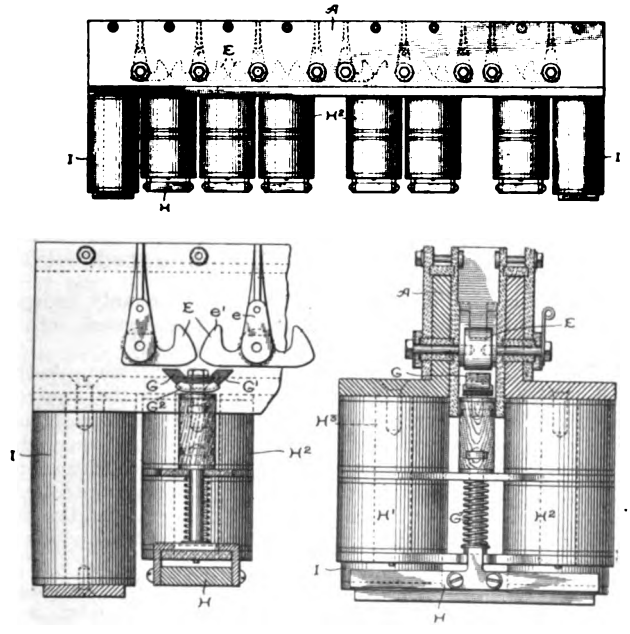
In our issue of October 1st last we commented, says the "Engineering and Mining Journal," on the cost of 1.3 cents a pound for refining copper electrolytically, which was obtained from the report of the Anaconda Company, as a very high one, in view of the rates at which such work is now done. We are now informed that the charge for refining pig copper electrolytically made by the custom works rarely exceeds 1 cent a pound and that the work is frequently done at ⅞ cent a pound. As the refiners naturally expect to make a profit on their work, the cost of refining must be less than the figures named, and the Anaconda figure is supposed to represent cost on at least a large part of their output. The charge for refining cathodes is now put as low as ⅛ cent a pound as a minimum, and 0.15 cent is not an uncommon rate. These figures quite sufficiently support our statement that the cost of refining reported by the Anaconda Company is high, especially when it is remembered that the company controls its supplies of fuel and other materials.



Prof. Elihu Thomson's System of Electric Train Control.

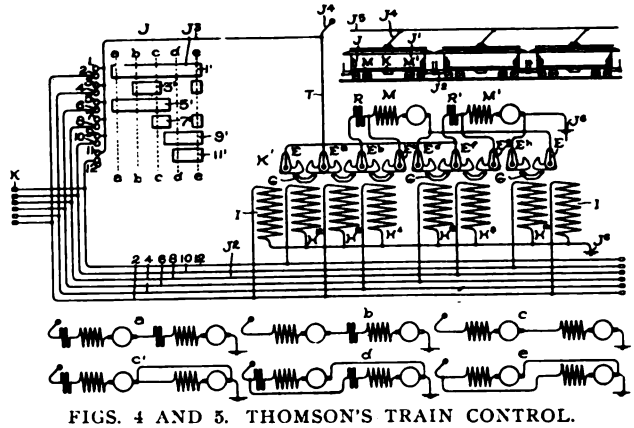
THE experience of the past in handling electric trains makes it safe to assert that the standard method of operating such trains will probably be by making each car a unit by itself, with the entire train controllable from one or more points on the train. The results on the Chicago elevated roads have shown that such a system is conducive to economy in several ways, while it makes the question of traction, acceleration, etc., entirely independent of the number of cars constituting a train—conditions which could evidently not be met by the system involving a single motor car with dead trailers.

A system of train control designed to enable the train consisting of individual units to be operated from a single point has recently been devised by Prof. Elihu Thomson, and possesses a number of interesting features. The individual motor controller consists of a series of switch magnets illustrated in Fig. 1, and in detail in Figs. 2 and 3. The two angle irons from which the magnets are suspended constitute the pole pieces of a blow-out magnet for breaking any arc which may be formed between the contacts. The contacts E have horns e^1, e^2, which taper inward so that the arc formed becomes longer and longer and finally reaches such a length that it breaks itself.



FIGS. 1, 2 AND 3. THOMSON'S METHOD OF TRAIN CONTROL.

At the extreme ends of the angle irons are shunt-wound magnets, I, which are energized whenever the motor circuit is closed and furnish an initial field for the blow-out magnet. The controller just described is the individual motor controller. In addition, however, Prof. Thomson supplies a master controller, illustrated, together with its method of operation, in Figs. 4, 5, and 6. The operation of the system will be readily comprehended, it being understood, of course, that the cable J^2 passes through all the cars and connects the controllers of each motor with the master controller.



FIGS. 4 AND 5. THOMSON'S TRAIN CONTROL.

With the brushes of master controller J resting on line a a the motor circuit is as follows: The current enters from trolley J^4 and passes by wire T to contact Ea, to contact Eb, through resistance R, and field and armature of motor M in series to contact Ed, by contact G, to contact Ef, to resistance R', field and armature of motor M' in series to ground J^6. With the circuits arranged as above the motors are connected as at a, Fig. 6.

As the blow-out magnet coils I I are permanently included in circuit when the contacts of the master controller engage with the stationary brushes further reference to them will be omitted.

To increase the speed of the motors, the master controller is moved farther to the left, so that the vertical line of brushes will rest on line b b. With this connection the motors are as shown at b, Fig. 6—that is to say, the motors are in series, with one-half the resistance cut out. To further increase the speed of the motors, the master controller is moved to the left until the brushes rest on the line c c. The circuits in this instance are the same as above, wth the exception that the coil H^5 is included in circuit, which closes the circuit of the main controller between contacts Ef and Eg and cuts out resistance R'. The motors are now coupled, as shown at c, Fig. 6.

The continued movement of the master controller to the left interrupts the circuit of magnet H^4, permitting contact G to drop and insert resistance R. The next instant contact 9' bridges the brushes 9 and 10 and coil H^{10} is energized, which closes the circuit between controller contacts Eh and Ei. This places a shunt around motor M', as shown at c', Fig. 6, preparatory to connecting the motors in multiple. When the cylinder is moved to the point where the brushes rest upon line d d, the circuit of the master controller causes the contacts G to shunt resistances R and R', and the motors are connected directly in parallel between the source of supply and the ground, as shown at e, Fig. 6.

It will be seen that the entire operation of the motor-controller is controlled by the master controller which regulates the operation of the switch coils H. As these coils are made of fine wire and are connected in shunt to the circuit, only a very small amount of energy is required to operate the main contacts on the motor controller.

As the contacts are maintained in circuit with the motors only when the switch coils are energized, it will be seen that in the event of failure of the source of supply all of the contacts on the controller will return to the off position, and the motor circuit will be interrupted automatically at a number of points.

When for any reason the power circuit is interrupted, the motor circuits are also instantaneously interrupted. If now it is desired that upon the restoration of the circuit the motor controllers shall be simultaneously placed in the position which they occupied before the interruption, as would be the case where the

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interruption was only momentary, such as that caused by the presence of ice or paper upon the conductor, the motorman has simply to leave the controller in position and the result will be effected. If, however, the interruption is continuous for such a time that the speed of the motors materially decreases, it is only necessary for the motorman to place the master controller in the position corresponding to the position in which he wishes the motor controllers to be placed, when the circuit is restored, and the motor controllers will then immediately upon restoration assume the desired position.

It will also be noticed that in this system of control the motor controllers and master controllers are in positive synchronous relation, so that when the master controller is placed in any position the motor controllers instantaneously assume the corresponding position without any appreciable time intervening and that any motion of the master controller forward or back one notch or several notches will be instantaneously and accurately responded to by the motor controllers.

Large Trolley Consolidation in Northern New Jersey.

WITH the acquisition early this month by the North Jersey Traction Company of the North Hudson County Railway Company, there has been a consolidation of street railway interests across the North River unequaled in any other suburban section of the country. Following the former unification of interests a similar process has been followed in the electric lighting companies, as noted in our comprehensive article on the Newark Peoples Company in The Electrical Engineer of Jan. 5. What makes necessary the mention of the two together is the growing unification of power plants and the fact that the leading men in each organization are the same. Within the last few days their names have been cited as negotiators for street railway and lighting properties in the several boroughs of New York City. There are at present three distinct street railway systems in operation in northeastern New Jersey—the North Jersey Street Railway Company, Orange and Passaic Valley Street Railway and the North Hudson County Railway Company. Of these apparently the least important is the Orange system, but in future possibilities it is looked upon by the men at the head of the three systems as the most important. The consolidation of interests effected in Jersey City in the first week of this month brings forward a power capable of contending with the steam railways for the control of the most valuable public privileges in New Jersey. The roads controlled by the consolidated interests are as follows: North Jersey Street Railway Company, comprising the Consolidated Traction Company; Jersey City and Bergen Railroad Company; Jersey City, Harrison and Kearney Railroad Company; Newark Passenger Railroad Company; New Jersey Traction Company; Passaic and Newark Electric Railway Company; Passaic and Newark Electric Traction Company; Newark Plank-Road Company; Port Richmond and Bergen Point Ferry Company; Bergen Point and Staten Island Ferry Company, and Newark and South Orange Railway Co. Orange and Passaic Valley Railroad Co., known as the suburban line, which runs through Orange to Bloomfield at present, and has the right of way through the Passaic Valley to Paterson into Passaic County, north, and south through Union County, and west through Morris County. The North Hudson County Railway Company, comprising the lines in Hudson County not controlled by the North Jersey Street Railway Company.

The combined companies represent a capital of about $70,000,000, and are paying interest on $25,000,000 worth of bonds. They embrace a territory at present from Elizabeth north to Paterson, east to Englewood, south to Staten Island. The only railways in this section not absorbed are in the hands of receivers, the Rutherford and Passaic Street Railway Company and the Union Traction Company. It is believed that both will soon be bought up.

The men interested in controlling the foregoing street railways are: P. B. A. Widener, William B. Elkins, Randolph Morgan and Thomas F. Dolan, of Philadelphia; William C. Whitney, J. D. Crimmins and Patrick H. Flynn, of New York City; Senator James Smith, B. M. Shanley, Leslie D. Ward, Elisha Gaddis, Gottfried Krueger, of Newark; E. F. C. Young, of Jersey City; Garret A. Hobart and Augustus Barber, of Paterson, and John Kean, Jr., of Elizabeth.

It is interesting to remember that but ten years ago there was little electric traction in New Jersey, practically no consolidation, and considerable confusion in the operation of the street railways with so many conflicting interests. The first consolidation occurred when the Newark Passenger Railway Company sold out to the New Jersey Traction Company. The former had a capital of $100,000. The latter was capitalized at $500,000. Then came the Consolidated Traction Company, which bought everything in sight except, for a long time, the Newark and South Orange Railway Company. Its capitalization was $15,000,000. The Newark and South Orange Railway Company, when bought by John Radel in the 70's, was purchased for $35,000. When last sold it brought $3,500,000. The North Jersey Company absorbed the Consolidated Traction Company last May, taking possession on June 1.

It has been noted that the men interested in the traction consolidation are also interested in the union of lighting interests. There is a method in this apart from the desire to make good investments. It has been estimated that if the lighting companies and electric railway companies joined hands it would result in great saving to each. Embraced in this consolidation of traction and lighting interests is a scheme that intends practical and early competition with the Delaware, Lackawanna and Western Railroad Company as far west as Dover.

Electric Railway Consolidation Around Boston.

A well-defined belief exists in Boston that a consolidation of electric railway interests, involving the North Shore Traction Company and various other electrical systems north of Boston, is under way. As the scheme is at present understood, it includes the consolidation of all electrical railway interests along the north shore, the North Shore Traction Company, which controls the Lynn and Boston, and allied lines. The extent of the new system planned is to be limited only by the coast line of New England from Boston into New Brunswick. At the present time there is a continuous line of electrical railways running from Boston to Portland, connecting the important cities along the coast, with a few breaks, aggregating twenty-five or thirty miles. The construction of those connecting links is being arranged. The operation of the lines is under the control of many different companies, but the interests back of the consolidation plan are well represented, and an ultimate combination is not likely to be a difficult matter.

Contracts, it is said, have been arranged with construction firms for the building of projected lines which are to connect every important seaport along the coast from Boston, through Massachusetts, New Hampshire and Maine, to the Canadian border, and it is expected that the work is to be completed within the next two years.

Brooklyn Trolleys Consolidated.

The Nassau Railway system, operating the only independent trolley lines in Brooklyn, has at last passed into the control of the Brooklyn Rapid Transit Company.

This will give ex-Governor Roswell P. Flower, Anthony Brady, Richard Croker and their associates in the control of the other Brooklyn surface lines, a complete monopoly of all means of passenger traffic in the Borough of Brooklyn, with the exception of the elevated railroads. Mr. Flower is known to be after them, too. Negotiations for the purchase of control of the Nassau Company have been in progress for a year and the premature announcement that it was completed has been made several times.

The deal eliminates Mr. Tom L. Johnson, of Ohio, and his brother Albert from street railroad business in Brooklyn, which they have done so much to revolutionize and develop. The Johnsons entered this field several years ago, consolidated several lines and built others, established a system covering all parts of the city of Brooklyn and its suburbs, and fixed a five-cent fare to any point on their lines. They took an enormous amount of traffic from the other lines, and forced generous concessions to the public from their rivals in the way of better cars, more transfers and faster service. This cut into profits deeply.

The new consolidated system will represent about 400 miles of road, and probably from $35,000,000 to $40,000,000 in capitalization.

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A Trolley Line between Cleveland and Pittsburg.

A special despatch from Cleveland, O., of Jan. 12 says: It is practically settled that Cleveland and Pittsburg will be connected by an electric line. Dr. R. S. Hubbard, ex-County Treasurer, is promoting the enterprise, and was in Washington Wednesday in connection with it. He will visit New York and Philadelphia with a view to interesting capitalists in those cities in the project. Mr. Hubbard is president of the Cleveland & Chagrin Falls line, which will form part of the route. Work is now in progress to extend the Chagrin Falls road to Warren. It will connect there with a road now in operation between Warren and Youngstown.

From Youngstown connection will be made with the suburban lines running out of Pittsburg. Much of the route will be over private right of way, and through electric trains between Cleveland and Pittsburg are to make a schedule time of forty miles an hour.

Hill Climbing Automobile Tests in France.

The data now arriving on the hill-climbing tests of the French Automobile Club late in November appear to demonstrate very considerable capacity on the part of many of the vehicles. The hill surmounted was that at Chanteloup, near Paris, the slope of which varies up to 11 per cent., or about 1 in 9. The length of the hill is 1,800 km.—a distance covered in 3 minutes 52 secons by the winner, M. Jenatzy, with an electric carriage. The battery was very powerful. The total weight of car was 1,800 k., and over 28 h. p. was developed in places, which seems enormous, and Mr. Farman, in "Industries," considers any longer duration would have completely disabled the batteries, whereas petroleum cars would have gone on all right. Eleven of the contestants did the journey under 5 minutes, the remainder tailing off to a maximum of nearly 23 minutes. The second vehicle required only 10 seconds longer that the electrical car. It was a single seat Bollée Voiturette, and had a motor of 8 h. p. The speed of the winner was nearly an average of 30 km. per hour—a most respectable performance, as, indeed, were all the runs under 5 minutes, for they represent speeds of above 21 km. per hour, or about 14 miles. If autocars will run at this speed up grades of from 3 to 10 per cent. with motive power of reasonable dimensions, the future of such cars must be good. There were 45 vehicles in the competition, and over 200 vehicles present in all. Mr. Farman is himself a petroleum vehicle man, and may be biassed against the electrical vehicle, which he affirms would have been disabled by an hour's similar contest. It must, of course, be some time before electrical vehicles can have so wide a range as petroleum cars, the success of which will not have a retarding effect on electrical cars, but, on the contrary, will tend to their extension, and will assist to familiarize the public with motor cars generally.

"L'Energie Electrique" on this general subject cites Pierre Giffard as saying: "This is indeed the end of the horse." In a certain dialect story, in which a donkey was wound up a mill hoist, the man who tried to land the animal endeavored to do so by pulling him by the tail. The result seemed to justify his expression, that there were two ends to a jackass, and one of them was the wrong one, for it kicked. Whether the right end of Pierre Giffard's horse has come the near future should prove.

The statement was made on the strength of the results of the recent automobile trials in France. "L'Energie Electrique" states that of 19 vehicles three were electrical. The electrical vehicles ran 66 kilometres without recharge, whereas the steam and petroleum vehicles took on fresh supplies, and all along the route were visible vehicles filling up supplies. The tests in question were made on Oct. 6 and 12. There were three routes of about 40, 45 and 67 kilometres, respectively; the first was the most easy, the second was the hardest with heavy gradients. The third route was long and difficult. The route seems to have been chosen to the advantage of steam vehicles, the gradients coming in at the end of the journey.

The Jenatzy van had a battery of 1,360 k. in 44 elements. The front wheels carried 1,610 k., the back wheels 2,540 k., in working order. The empty vehicle weighed, with the driver, 3,090, and the load was 1,060, giving a total of 4,150 k. as above divided.

Last year "L'Energie Electrique" estimated that 120 watt-hours of energy were necessary per ton kilometre. This figure had come down to 100 watt-hours in June last, and it was now estimated as only about 85 on the route Versailles and St. Germain at a speed of 12½ kilometres. In the long descents, as to the bridge of Suresnes, over 50 per cent. of the energy spent on this section was recuperated, so that the actual expenditure was as low as 30 watt-hours per ton kilometre.

The conclusions are all in favor of the electric vehicle for large towns or for such work as that of a country doctor where there is a convenient charging station, which, as a rule, will be available at no great distance.

Connection of Stationary Motors to Trolley Circuits.

THE subjoined correspondence will probably be of interest to many readers of The Electrical Engineer. It includes an inquiry from Mr. W. A. Fraser, the city electrician of Dallas, Texas, and a reply from the editor of this journal. The subject is the propriety of connecting stationary motors to trolley circuits, which Mr. Fraser has forbidden. We shall be glad to hear from any engineers or local companies on the subject. One of the points that suggests itself is that under the later conditions of current generation and transformation, some modification of the insurance rule referred to may have become possible..

Dallas, Texas, Jan. 7, 1899.

The Electrical Engineer, New York.

Gentlemen.—We have under discussion the proposition of whether the use of a grounded trolley circuit to run motors in business houses is dangerous or not. I contend that it is dangerous to both life and property.

The street car company contend that those are antiquated ideas, and that grounded circuits are not more dangerous than metallic circuits. They made one connection, and I had them to cut it off as soon as I found it out. They appealed to the city council, and I made them the proposition that I would submit the matter to the highest authority in the country. I therefore ask that you write me your ideas from an electrical standpoint. I believe that this is a matter which concerns the public at large, and I hope you will favor me in this matter; probably I may be able to return the compliment at some future date. Thanking you in advance, I am, truly yours, W. A. FRASER.

New York, Jan. 10, 1899.

Mr. W. A. Fraser, City Electrician, Dallas, Texas.

My Dear Sir.—We are in receipt of yours of Jan. 7 in which you submit the question whether the use of the grounded trolley circuit to run motors in business houses is dangerous or not. In answer to this question we beg to state that the highest authorities strongly condemn the practice mentioned, as most reprehensible.

There is no more stringent rule in the "National Electric Code" than Rule 36, which reads as follows:

Lighting and Power from Railway Wires.—Must not be permitted, under any pretense, in the same circuit with trolley wires with a ground return, except in electric railway cars, electric car houses and their power stations, nor shall the same dynamo be used for both purposes.

These rules have been adopted by most of the leading fire underwriters' associations, the National Electric Light Association and the leading engineering societies of the country. They are gotten up with the greatest care by men who rank as authorities on questions of electrical wiring, rules and requirements to insure safety, and the fact that these rules have secured such general adoption is sufficient evidence of their great value and authoritativeness.

We heartily endorse your action in cutting off the connection which you mentioned from a business house containing a motor connected to the trolley circuit. In fact, so pronounced is the general verdict on this subject, that we are astonished that this question should be raised again at this late day. Very truly yours, J. W.

Passenger Travel in New York City.

The annual report of the New York State Railroad Commission shows that in 1898 the total number of passengers carried by the elevated roads was 227,776,552, a decrease of 1,019,129 as compared with 1897. The number carried by the elevated roads in the Boroughs of Manhattan and the Bronx was 183,360,846, an increase of 395,995 as compared with 1897. The number carried by the elevated railroads in the Borough of Brooklyn for 1898 was 44,365,706, a decrease of 1,465,124 compared with 1897.

The street surface railroads of Manhattan and the Bronx car-

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ried as passengers last year 456,963,753, including "transfers," an increase over 1897 of 57,538,010. The number carried in the Borough of Brooklyn (including some carried in the Borough of Queens) was 217,410,612, including "transfers," an increase over 1897 of 17,224,793.

The commission reports that the question of overcrowding cars is serious and in the Boroughs of Manhattan and Brooklyn especially it is one which has not been solved. The companies operate as many cars as practicable, but the local conditions are such that it is impossible to provide seats for all passengers at certain hours of the day. The hope is expressed that when the change of motive power is completed the situation will be improved on Manhattan Island.

Insulated Wire Manufacturers and the Underwriters.

A conference was held last week in Chicago between the underwriters and the representatives of sixteen manufacturers of insulated wires and cables, to bring about a better understanding as to insurance requirements on the subject of rubber covered insulated wires, etc. A great deal of satisfactory, preliminary work was done, and the basis laid for future standards in this respect.

The Consolidation of Train Signal Companies.

All of the apparatus heretofore made by the Johnson Railroad Signal Company, the National Switch & Signal Company and the Union Switch & Signal Company, will be supplied by the Union Switch & Signal Company, under which title all business will be conducted. The works at Swissvale and Easton will be improved and maintained so as to secure a minimum cost of production, with maximum facilities for handling the business. A Department of Sales and Installation has been created, with Mr. Charles Hansel, C. E. (formerly vice-president and general manager of the National Switch & Signal Company), as manager, with offices at 43 Cedar street, New York City, and he announces the following appointments, effective Jan. 1, 1899: Henry M. Sperry (formerly signal engineer and Western agent of the National Switch & Signal Company), as signal engineer and representative, with office at 43 Cedar street, New York City; V. K. Spicer (formerly signal engineer and agent, Western District, of the Union Switch & Signal Company), as signal engineer and representative, with office at 1535 Monadnock Building, Chicago. This department will have full charge of all quotations for contracts and material, and the installation of all work.

Exports of Electrical Material from New York.

The following exports of electrical material are from the port of New York for the week ending January 10: Antwerp, 16 packages electrical material, $1,751. Argentine Republic, 234 packages electrical machinery, $11,421; 1 case electrical machinery, $296, British Possessions in Africa, 2 packages electrical material, $10; Bremen, 8 cases electrical material, $1,250; British West Indies, 2,475 cases electrical material, $11,521; Berlin, 28 packages electrical material, $1,635; 2 cases electrical material, $800; Brazil, 20 packages electrical machinery, $665; 32 cases electrical material, $861; British East Indies, 20 cases electrical material, $2,337; 19 packages electrical machinery, $2,134; Boulogne, 5 cases electrical material, $71; British Australia, 4 cases electrical material, $45; China, 7 cases electrical machinery, $300; Cuba, 53 cases electrical material, $1,280; Chili, 11 cases electrical material, $220; Dublin, 1 package electrical material, $65; Hamburg, 112 packages electrical material, $5,809; Hull, 38 cases electrical machinery, $7,914; 31 packages electrical material, $818; Havre, 78 cases electrical machinery, $8,199; 8 cases electrical material, $120; Japan, 6 packages electrical machinery, $740; 87 cases electrical material, $3,940; Leith, 10 cases electric motors, $563; London, 234 packages electrical material, $11,711; 42 cases electrical machinery, $2,000; Liverpool, 78 packages electrical material, $3,905; 78 cases electrical machinery, $7,140; 4 packages electric motors, $2,571; 1 case electrical material, $45; Mexico, 3 packages electrical material, $120; Marseilles, 20 cases electrical material, $2,400; Oporto, 4 cases electrical material, $101; Peru, 6 cases electrical material, $48; Rotterdam, 5 cases electrical material, $250; Southampton, 45 cases electrical machinery, $1,020! 4 cases electrical material, $86; Siam, 2 cases electrical material, $90; U. S. Colombia, 52 packages electrical material, $1,516; Uruguay, 3 cases electrical material, $77; Venezuela, 68 packages electrical material, $1,752; Warwick, 2 packages electrical material, $52.

Brother John on Jonathan's Trade.

Sometimes a glance at what other folks are doing does good—sometimes raises the bile. It may, we hope, do good to see how Brother Jonathan is trespassing upon our own ground. Just glance at his exports of electrical apparatus to England and its colonies for a week. The value of such apparatus on the week ending Dec. 6, the last for which we have the figures, reached the respectable sum of over $25,000, the total exports reaching nearly $60,000, so that England and her colonies are taking a goodly share of apparatus from America. If we were to include such places as Egypt, the position is still worse against us. There is no reciprocity in this trade. America does not absorb our goods to anything like this, and—well, and—we have nobody but ourselves to thank for this state of things. Taking the week as an average sample of the weeks in the year, it means that we take over a million dollars' worth of electrical apparatus from America out of the three million odd dollars' worth exported. Is it that we cannot make the apparatus so cheaply, or is it that a nation of shopkeepers is beaten at its own business?—London Electrical Engineer.

"The Living Age."

Several features of striking interest will be found in the opening numbers of "The Living Age" for the new year. The number for January 7 contains, among other things, a pungent and wholesome lecture on Art and Morality, by M. Ferdinand Brunetiere, which is translated for the magazine and copyrighted by it; the first instalment of The Etchingham Letters, which are attracting wide notice in "The Cornhill" by their cleverness; and the beginning of a short serial. The number for January 14 gives the full text of Lord Rosebery's recent address on Literary Statesmen, which has been the subject of general comment; an article from Blackwood's on The Ethics of Conquest, which relates to the Philippines; and a bright paper on The Madness of Mr. Kipling.

Proposed Consolidation of Lighting Fixture Concerns.

LEADING manufacturers in this country of gas and electric fixtures have a plan under way to consolidate their interests. The output of these concerns in this country amounts to about $6,000,000 a year, and is rapidly increasing. There are only about twenty large establishments, and most of them are in this city and Philadelphia. There are others, however, in Chicago, Cleveland and San Francisco. As to possible saving, it is stated that at the time the Waldorf Hotel was being built the owners were prepared to pay $100,000 for the electric light fixtures in the building. The manufacturers of the fixtures were at each other's throats for the contract. So fierce was the competition that the contract finally went to the successful concern for $56,000. There was no profit at this figure. In fact, it is said that the manufacturers lost about $15,000 by the transaction. A few instances of this sort set the different manufacturers to thinking how much better it would be if competition were wiped out, and finally the present plan was evolved. It has not yet been definitely agreed upon, but the probabilities are that the consolidation will be effected within a short time. There is also talk of some time in the future, after the consolidation has been proved a success, of purchasing a piece of land within easy reach of this city and building on it a large factory to supply the entire Eastern market. There would also be a branch factory somewhere in the Middle States and another in San Francisco.

Over ten years ago the manufacturers of gas an electric light fixtures formed an agreement to prevent serious competition and the cutting of rates. Then, in 1893, the hard times came, and the manufacturers began to break away from the agreement and to

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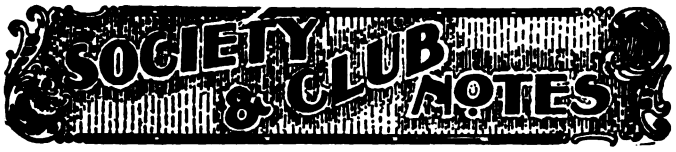
cut prices again. This cutting of prices has been going on ever since. It was last fall that the manufacturers began the movement for the consolidation which is apparently so nearly realized. Edward R. Johnes, a lawyer, of 50 Broadway, represents the manufacturers in arranging the consolidation.



Storage Battery Night at the New York Electrical Society.

"Standing room only" was the lot of late-comers at the one hundred and ninety-third meeting of the New York Electrical Society at the College of the City of New York, Jan. 12. The Subject of the evening, which was "Latest Progress in Storage Battery Installations," was ably handled by Mr. Joseph Appleton, engineer of the construction department of the Electric Storage Battery Company. The meeting was a significant illustration of the number now interested in storage battery application, and the audience listened with close attention to Mr. Appleton's record of the triumphant way in which the storage battery has vindicated the faith of its friends through years of doubt and opposition. The lecture, which was of exceptional interest throughout, was illustrated by a large number of lantern slides.

After the discussion, in which Mr. R. P. Bolton, Mr. Frank J. Sprague and Mr. C. O. Mailloux took part, the company visited the storage battery power substation of the Metropolitan Street Railway Company, at the foot of West Twenty-third street, where was seen in operation the large railroad battery of the company, equipped with all the modern appurtenances.

The following members, all of New York City, were elected at the meeting: Arthur D. Dunn, E. E., 164 East Eleventh street; Harvey E. Mole, J. S. White & Co., 29 Broadway; James A. Stiles, Newton Appliance Co., 120 Liberty street; Henry I. Lurye, electrician, 110 East 109th street; Walter S. Wilson, 111 Fifth avenue; A. Haaber, New York Insulated Wire Co., 15 Cortlandt street; Eugene F. Roeber, Ph. D., 210 West Fourth street; Herbert Jenkins, New York Insulated Wire Co., 15 Cortlandt street; George V. Flynn, 26 Thames street; Arthur Diamant, 4 East Ninety-seventh street.

Dr. Eugene Obach.

We regret to announce the death of Dr. Eugene Obach, F. I. C., F. C. S., who for years has acted as chief of the experimental department of Messrs. Siemens Bros. At the time of his death he was staying in Austria with the hope of regaining his health. His work and data have been of great value to the electrical and other arts.

Milan C. Bullock.

A FINE, strong personality passes from the American engineering field in Mr. M. C. Bullock, whose death last week we regret to have to record. He had been suffering for the last eighteen months from sciatic rheumatism, and a cold on top of that developed into bronchial pneumonia, to which he succumbed on Jan. 12 at the age of sixty.

It would require more than one page of this journal to tell all the engineering and mechanical work that our stalwart, genial friend engaged in, but we must restrict ourselves to saying that it ranged from mining and mill work to the latest phases of electricity and engine practice; from his native State of New York to the far West and still farther Peru. After many adventures and vicissitudes he started the M. C. Bullock Mfg. Co. in Chicago in 1878, and in 1892-3 he took up the manufacture of the famous Willans central valve engines for this country, since which time the concern has done an enormous business in all branches of the mining and machinery field.

Mr. Kimberly, of the M. C. Bullock Co., writing us of its late president, says: "He was a staunch and true friend, and in his business dealings the soul of honor—his actions were above reproach. To his employees, he was more like a friend and comrade than an employer, and he enjoyed the esteem and respect of all who knew him." What finer epitaph could any man ask than that?

Joel C. Clark.

Joel C. Clark, secretary of the New York and New Jersey Telephone Co., died at his home in Brooklyn, Jan. 11. He had been ill about a month, suffering from a complication of diseases. The deceased was 57 years old and had lived in Brooklyn about five years. His home was in South Framingham, Mass., where the remains were taken. There were private funeral services at his late residence.

Joel C. Clark was born in Hallowell, Me., and at one time was a member of the Massachusetts Legislature. He was one of the incorporators of the New York and New Jersey Telephone Company and the New York and Pennsylvania Telephone and Telegraph Company, of which companies he was a director since their organization. At the time of his death he was treasurer of the New York and Pennsylvania Company and secretary of the New York and New Jersey Company. Prior to entering the telephone business he was engaged as a printer in South Framingham, where he was well known and highly esteemed. He had considerable literary ability and was a frequent contributor to the magazines and newspapers. A widow, five daughters and two sons survive him.

The Right to the Name "Armington—Sims."

The Rhode Island Supreme Court has decided that the Armington & Sims Company, of Providence, R. I., must not use that name in the future in the conduct of their business. Messrs. Pardon Armington and Gardiner C. Sims, both stockholders in the old Armington & Sims Engine Company, are not any longer connected with the new company in any way, and have therefore objected to the use of their names in the company. It is agreed that the Armington & Sims engine as now known may still be constructed by the new company, and the right to use the name is the only thing in contention which they are now, by the action of the court prevented from doing.

A Wonderful Week of Advance.

The past week was one of remarkable business and general activity, particularly in stocks. All staples were strong, notably iron and steel, cotton and wheat, and the foreign demand not less than the domestic was very large. Another feature of the situation was the announcement of a number of new industrial consolidations. Bank clearings again broke all records, railroad earnings were again 8 per cent. higher, while telegraph, cable and telephone traffic is running very heavy.

During the week, 19,388 shares of Western Union were sold, closing strongly at 94⅝. Of General Electric, 11,530 shares were sold, up to 102⅛ and closing at 100¼. New York Edison was steady at 192, and Metropolitan Street Railway, on small sales, a little weaker at 189¾. In Boston there was great strength in telephone stocks, and Am. Bell went to 295.

Copper during the week advanced to 13.62½ cents, New York; and there are expectations of further gain. A big copper combination is said to be afoot. Heavy steel rail, Eastern mill, was $18.

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INVENTORS' RECORD

Classified Digest of U. S. Electrical Patents Issued Jan. 10, 1899.

Alarms and Signals:—

RAILWAY SIGNAL SYSTEM. Frederick C. Esmond, of New York, N. Y., assignor to the Esmond Electric Traction & Signal Co., of West Virginia. 617,325. Filed March 17, 1896. A block system providing both a warning and a danger signal to the engineer, distinguishable according as the threatening train is proceeding in the same direction or coming in the opposite direction.

FIRE ALARM. George W. Fallin, Sherman Heights, Tenn., 617,326. Filed Jan. 20, 1898. Embodies a float placed in a tube containing mercury or some other expansible liquid by means of which the circuit is closed.

ELECTRIC SIGNAL. Charles A. Parrish, Jackson, Michigan, 617,540. Filed Aug. 4, 1897. Designed to be operated by a passing car.

AUTOMATIC ALARM MECHANISM FOR ELECTRIC MOTORS. Robert W. Traylor, Richmond, Va., assignor of one-half to Maurice W. Phillips, Philadelphia, Pa., 617,664. Filed June 22, 1898. Details of construction.

Electro-Metallurgy:—

APPARATUS FOR SEPARATING PRECIOUS METALS FROM THEIR ORES. James R. Macmaster, Pomeroy, Wash., 617,466. Filed May 16, 1895. Details of construction.

APPARATUS FOR EXTRACTING PRECIOUS METALS FROM ORES. Lewis E. Porter, Los Angeles, Cal., assignor to the Porter Gold & Silver Extraction Co., California, 617,512. Filed Aug. 18, 1896. The ores are dissolved in chemical solutions and the metal is treated electrolytically while placed within a rapidly rotated cylinder provided with interior screens and nettings.

APPARATUS FOR ELECTRO-DEPOSITION OF METALS. Elisha Emerson, Buffalo, N. Y., 617,526. Filed Dec. 16, 1896. An apparatus for the electrodeposition of copper comprising a cylindrical cathode, a series of horizontal anode bars in proximity to it, and curved supports for it, composed of lead with lugs forming receptacles for the anode bars, whereby the latter are maintained out of contact with each other and in the same relative positions as they are dissolved.

Electro-Therapeutic:—

ELECTRO-THERAPEUTIC AND MASSAGE APPARATUS. Oscar Schneider, of New York, N. Y., 617,543. Filed Aug. 17, 1898. A roller-electrode for galvano-faradic massage apparatus, consisting of wooden sections, metallic heads for the sections, and intermediate metallic strips connected alternately with the opposite heads of the roller.

Lamps and Appurtenances:—

ELECTRIC DEVICE. David Misell, of New York, N. Y., assignor to the American Electrical Novelty and Mfg. Co., of the same place, 617,592. Filed March 12, 1898. Consists of a dry battery and incandescent lamp contained within a tubular casing of such size as to be easily portable in a pocket.

ELECTRIC HEADLIGHT LAMP. Harlan P. Wellman, of Ashland, Ky., 617,621. Filed Sept. 15, 1898. An electric headlight lamp having positive and negative carbons, an enclosure for the carbons, means to which the enclosure is secured for adjusting the carbons and means for axially rotating the enclosure whereby the carbons may be relatively adjusted.

Measurements:—

ELECTRICAL MEASURING INSTRUMENT. George T. Hanchett and Frederick B. Sage, of Hackensack, N. J., 617,418. Filed May 2, 1898. Consists of a combination of the circuits of a Wheatstone bridge, a circuit closer each for the battery and bridge, both being attached to a single handle.

Miscellaneous:—

ELECTRIC TRANSFORMER. David H. Wilson, of Chicago, Ill., 617,381. Filed July 30, 1897. Comprises two coils, each having its own circuit, one movably mounted in the magnetic field of the other and normally so positioned that the magnetic forces acting upon it when the first coil is energized, will be unbalanced; and a varying device in the circuit of the first coil to which the movable coil is responsive.

ELECTRICAL RESISTANCE. Julius Ferdinand, Heinrich Voigt and Jacob Adolf Haeffner, of Bockenheim, Germany, assignors to the Roessler & Hasslacher Chemical Co., of New York, N. Y., 617,375. Filed Dec. 26, 1895. Consists of a suitable base-piece, an enamel layer secured thereto, and a conducting-layer of fired liquid metal.

Regulators:—

CONTROLLING ELECTRIC MOTORS AND TRAINS. Elihu Thomson, of Swampscott, Mass., assignor to the General Electric Co., of New York, 617,546. Filed Feb. 28, 1898. Embodies a plurality of separately actuated contacts for varying the motor speed; electromagnets for controlling the contacts and means for controlling the magnets from a distance. See page 95.

AUTOMATIC REGULATOR. George S. Neeley, of Pacific, Mo., assignor of one-half to Albert Koppitz, of same place, 617,598. Filed July 28, 1897. Designed primarily for alternating current dynamos.

SYSTEM OF CONTROL FOR ELECTRIC MOTORS AND RAILWAY TRAINS. William B. Potter, of Schenectady, N. Y., assignor to the General Electric Co., of New York, 617,601. Filed March 17, 1898. Comprises a number of motor cars, each of which is provided with a controller for its motor, the controllers being in parallel between the source of supply and ground, step-by-step actuating devices for each controller, a circuit including the step-by-step actuators, and a regulator in the circuit governing the actuators.

Switches, Cut-Outs etc,:—

LAMP SOCKET FOR STREET SERVICE. Welles E. Holmes, of Newtown, Mass., 617,464. Filed March 14, 1898. Embodies an elastic or resilient circuit closer operable to close the circuit through the socket when the lamp is removed, the circuit closer being automatically cut out of circuit when the lamp is in the socket.

CIRCUIT BREAKER. Paul R. Godley, of Philadelphia, Pa., assignor by mesne assignments to the General Equipment Co., of Camden, N. J., 617,503. Filed March 2, 1898. Overload circuit breaker. Details of construction.

ELECTRICAL CUT-OUT. Albert P. Seymour, of Syracuse, N. Y., 617,608. Filed Nov. 1, 1897. Comprises a fuse box provided with a chamber having interior longitudinal radially projecting faces, a rotatable fuse-carrying plug, provided with exterior longitudinal radially projecting faces adapted to contact with the radially projecting faces of the chamber, whereby the chamber is divided into two separate chambers, metallic terminals on the fuse box, and contact plates on the plug for engaging the terminals.

Telephones:—

TELEPHONE. Will E. Byrns, of Adams, Ind., assignor of one-half to John F. Huckleberry, of same place, 617,314. Filed May 27, 1897. A magneto telephone comprising a hollow core, a metallic diaphragm secured opposite one of the heads, a metallic bar constituting a conductor secured at one end to the diaphragm and adjustably secured at its other end to a stationary part, a helix upon the core in electrical connection with a battery and the diaphragm, and connections between the conductor and the line wire.

TELEPHONE SYSTEM. David H. Wilson, of Chicago, Ill., assignor to the Superior Electric Co., of same place, 617,382. Filed July 30, 1897. Comprises a transmitter, a receiver, an induction coil comprising two coils, one movably mounted in the magnetic field of the other, the parts so adjusted that there is a movement of the movable coil while the transmitter is being used, the movement of the coil aiding in varying the number of lines of force that thread the coil.

TELEPHONE. Theodore Berdell, of Summit, N. J., 617,433. Filed March 28, 1896. Comprises two diaphragms secured together and supported at their centres, and insulated from each other, in combination with an annulus of granulated material held between the diaphragms.

TELEPHONE SWITCHBOARD. James M. Overshiner, Elwood, Ind., 617,691. Filed Aug. 4, 1896. Comprises a series of combined drop devices and jacks, each comprising in a single structure, a magnet, a drop, a latch device for the drop, a rocking jack having a socket in its end for the reception of a plug and contact pins co-operating with the jack.

TELEPHONE SWITCHBOARD. James M. Overshiner, Elwood, Ind., 617,692. Filed April 10, 1897. Similar to above.

ANNUNCIATOR DROP DEVICE. William O. Meissner, Chicago, Ill., 617,702. Filed July 1, 1896. Details of construction.

REPORTS OF COMPANIES

E. G. Bernard Co.

At the annual meeting of the E. G. Bernard Co., of Troy, N. Y., on Jan. 10, the following officers were elected unanimously: President and treasurer, E. G. Bernard; vice-president, F. L. Stevens; secretary, H. T. Crissey.

National Carbon Co. Incorporated.

The National Carbon Company, with an authorized capital of $10,000,000, has now been duly incorporated in New Jersey. The incorporators are W. H. Lawrence, Myron T. Herrick, James Parmelee, Webb C. Hayes, all of Cleveland; J. C. Van Blarcum, of St. Louis; A. M. Young, of Brooklyn; J. M. Humbird and D. D. Dickey, of Pittsburg, and Hugh H. Hamill, of Trenton. The details of the company were given in The Electrical Engineer last week.

Another Outside the Carbon Consolidation.

Last week we were advised of the fact that the Solar Carbon & Mfg. Co., of Pittsburg, remained outside the new National Carbon Co. We are now in receipt of the subjoined letter from the United States Carbon Co., of Cleveland, Ohio:

The Electrical Engineer, New York.

Gentlemen:—Enclosed herewith you will find several newspaper clippings of the leading Cleveland papers, relative to the consolidation of all the carbon plants of the United States.

These articles are misleading and are liable to misinform the electrical trade, and we desire to call your attention to the fact that The United States Carbon Co. which is thoroughly equipped with the largest and most improved carbon machinery in the world and is prepared to manufacture and supply all varieties of electric light carbons, is in no manner connected or associated with the new carbon trust. We would respectfully request that in your notice of the consolidation you would prominently mention this fact so that the electrical trade will not be misled to believe that The United States Carbon Co. is included in the consolidation.

The articles now being published claim that all the carbon companies in the United States are in the consolidation, which does us a great injustice. Very truly yours,

THE UNITED STATES CARBON CO.,
Cecil L. Saunders, Vice-President.

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Minneapolis General Electric Co.

The Minneapolis General Electric Co. filed its charter of incorporation at Trenton, N. J., on Jan. 9. The incorporation of this company in New Jersey so soon after the incorporation of the American Electric Company is suggestive, and may indicate that the electric deal, of which the first indication was the incorporation of the New York Gas, Electric Light, Heat & Power Company, by William C. Whitney and his associates, is of greater magnitude than was at first supposed. The Minneapolis General Electric Company is capitalized at $2,100,000, of which $600,000 is preferred stock, carrying a cumulative dividend of 6 per cent., and $1,500,000 is common stock. The company is registered with the Corporation Trust Company, of New Jersey, through its attorney, James B. Dill, Esq. The powers of the corporation, as provided for in its charter, are very comprehensive.

Union Electricitaets Gesellschaft.

Advices have reached us from Berlin, Germany, that the factory of the well-known firm Ludwig Loewe & Co., manufacturers of the machinery and apparatus of the Union Electricitäts-Gesellschaft, has been bought and was taken charge of by this latter company on Jan. 1, 1899. The manager of the factory, Mr. Wilhelm Lane, formerly a member of the firm Ludwig Loewe & Co., will be the general superintendent of the Union Electricitäts-Gesellschaft. This company have also increased their capital stock, which will place them in a position to meet the growing demand for their apparatus, and to extend their factory facilities.

Bankruptcy of J. B. Wallace.

A dispatch from Chicago of Jan. 7 says: "John B. Wallace, manager of the Wallace Electric Company, Marquette Building, has filed a petition in voluntary bankruptcy in the United States District Court. The liabilities are $236,238. Mr. Wallace mentions no assets in his petition. The petitioner had labored several years under a burden of debts contracted in connection with the failure of the firm of Wallace & Sons, dealers in electrical supplies, Ansonia, Conn., in 1893. The petitioner's creditors are nearly all in Ansonia."

CHICAGO. At the meeting of the North Chicago Electric Company on Jan. 10 Mr. Yerkes recommended the formation of a new traction company, with a capital of $10,000,000 to $15,000,000, to absorb some nine feeder suburban lines on the north and west sides.

The 20th Century Movement.

Among all the great changes which the dawning twentieth century has wrought, few are more radical or more beneficial than the introduction of the electric motor vehicle. This briefly sums up the introduction of a descriptive circular issued by the American Electric Vehicle Company, 1545 Michigan avenue, Chicago, Ill. They have made a special and careful study of the requirements of this class of vehicles. The storage battery which they use combines power, lightness and compactness, and one charging will run a vehicle thirty-five miles at a cost of one cent a mile. The batteries can be recharged in the carriage in about three hours' time. The vehicles are equipped with a recording wattmeter showing the amount of electricity used and indicating the capacity remaining. Single reduction motors are employed, and the braking is done by means of band brakes. The catalogue describes all of these parts in detail as well as the steering lever, the reversing switch, lamps and various types of vehicles manufactured, a number of which are shown by means of handsome cuts. The catalogue, which is handsomely gotten up, will be sent to any one on application.

Who Uses Mechanical Draft?

This is a question asked by the B. F. Sturtevant Company, Boston, Mass., and is most exhaustively answered in a twenty-page catalogue just issued. Even the large list contained therein presents but a small proportion of the users of the 125,000 Sturtevant blowers which have been sold. The partial list given only includes the larger plants equipped by this company with engine driven fans. The names presented are, however, sufficient evidence of the fact that mechanical draft is an efficient substitute for chimney draft. If this were not so, orders would not be so frequently repeated. The customers are classed according to the use they make of their fans, under the following subheads: Those who use it for induced draft, forced draft, in connection with mechanical stokers, for mechanical draft, and those who use it in connection with bagasse burners. A number of sugar plantations in which they are used, as well as a large number of vessels in the United States and the foreign navies, steamships and steam yachts are also given.

The catalogue has a very handsome and highly artistic cover, which again shows that whatever the company does it does with care and with a view of satisfying those into whose hands their products might come.

Lundell Motors for Electric Power.

Another text book on "Electric Power" has just been issued by the progressive Sprague Electric Company, whose downtown office is at 20 Broad street, New York, N. Y., which though called by them "Catalog No. 58," is far from being solely a circular setting forth the advantages of their products. It is, as stated, a valuable text book and collection of data on the use of the electric motor for various power purposes, and in looking over its pages one is surprised to find that so many and such varied uses can be found for it. A number of pages are devoted to a description of the Lundell motors of various sizes and types. Later the controller is thoroughly described and illustrated, a few pages being devoted to diagram connections and the efficiency curves. One-half of the catalogue contains thirty full-page illustrations of modern applications of the Lundell motors, some of which are as follows: Linotype machines, press room with machinery driven by Lundell motors, motors attached to cylinder presses, embossing presses, job presses, ruling machines, paper cutters, lathes and other machine tools, portable tools, hydraulic pump, portable fire engines, house pumps, elevators, looms, automobiles, organ blowers and exhaust fans.

The illustrations, as is customary in the Sprague literature, and as may be expected from the Bartlett & Orr Press, are of the highest character, and show the machines and their applications off to great advantage. The catalogues are bound in a very handsome cover ornamented with a design in green, gold and terra cotta. The catalogue, which contains seventy-two pages, will be sent to any one on application.

Stanley & Patterson.

The twelfth edition of the above firm's catalogue on telephones has been received in its enlarged form containing many new specialties which have not previously been listed by the company. Thirty-two pages are filled with illustrations and descriptions of the various telephone apparatus and line supplies manufactured and sold by the company. By applying for the same, at the company's offices, New York City, this catalogue will be sent to any one interested in telephone apparatus and construction work, and it will be found very interesting.

Western Electrical Supply Co.

The Western Electrical Supply Co., of St. Louis, Mo., have been mailing broadcast, throughout the entire United States, their new No. 18 Catalogue, devoted exclusively to house goods and telephone supplies, and will be pleased to mail a copy of this catalogue to any one in the electrical or telephone business, who may have been omitted from their list, upon request of the parties wishing a copy. They illustrate many new and attractive electrical devices of interest, making it a valuable addition to the files of any one using this line of supplies.

JOHN T. LISTER, of Cleveland, an old Brush man and arc lamp inventor, claims to have a system for the commercial extraction of the earth's latent electricity.

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The Central Electric Co.'s Catalogue.

As an indication of the appreciation with which the trade regards the Twentieth Century catalogue, issued by the Central Electric Company, who are daily in receipt of testimonials, the following are regarded by the Central Electric Company as compensatory: "We hereby acknowledge the receipt of your grand general catalogue and discount sheet. Please accept our thanks for same, and when in need of any material we will send in our order."

Another runs: "We beg to acknowledge receipt of the copy of your new catalogue, and wish to compliment you on this very elegant publication. It is a credit to your firm, and we hope will be the means of largely increasing your business. It certainly will prove of great value to all purchasers of electrical supplies, as it seems to be nearer perfect than anything in this line heretofore published."

SPRAGUE ELECTRIC CO., 20 Broad street, New York City, have issued a special beautiful calendar which will occupy a prominent position in any office lucky enough to receive it. It is as much a framed picture as a calendar. They have also issued a most valuable pocketbook calendar, with data, writing spaces, etc., which is equally welcomed by all recipients.

THE H. T. PAISTE CO., of Philadelphia, are issuing to the electrical trade, a very artistic calendar for 1899. Many of our readers will recall a calendar which this firm distributed several years ago, illustrating a girl putting up her hair (A Switch?) Their 1899 subject is "Good Night," by Grust, and is a beautiful reproduction of the lights and shadows which make this painting famous. It is sent upon receipt of 4 cents in stamps to cover expense in mailing.

TRADE NOTES AND NOVELTIES

Westinghouse Apparatus for the Paris Metropolitan Road.

The Westinghouse Electric & Manufacturing Company got word last week that its newly organized French Westinghouse Company has got the contract for the electrical equipment of the Paris Metropolitan Railway. The apparatus will be made at the company's works at Havre, formerly the Heilmann locomotive works. The contract is one of the largest recently given out for electrical work in Europe.

Ritter Soldering Iron Attachment.

The very simple patented device is very often of more value to the users and the originator than a complicated piece of apparatus. The Ritter Soldering Iron Attachment is an example of the value of a "very simple device." As the name partly indicates, it is a small soldering iron tip designed to be attached to the burner of an ordinary gasoline blow torch. The tip may be attached or removed instantly with an ordinary screw driver, and is capable of doing all of the work of an ordinary soldering iron. It has the advantage of being light and convenient to carry around, and of being always hot and ready for use as long as the torch is burning.

The Electric Appliance Company is introducing this specialty, and state that they have no difficulty in selling one or more to every construction man to whom it is shown.

Burhorn & Granger.

This firm having found their old quarters inadequate to handle their increasing business, have removed to the White Building, Nos. 95 and 97 Liberty street, New York. They will continue to represent, as they have in the past, the following manufacturers: Stearns Mfg. Co., Erie, Pa.; Harrisburg Mfg. and Boiler Co.; Philadelphia Engineering Works; Union Iron Works, Erie, Pa.; American Fire Engine Co., Seneca Falls, N. Y. Messrs. Burhorn & Granger extend to their friends and all intending purchasers a cordial invitation to visit their new offices.

Western Telephone Construction Co.

In order to complete the negotiations for purchasing a manufacturing plant near this city, J. E. Keelyn, president of the Western Telephone Construction Company, of Chicago, was in Pittsburg yesterday, says the Pittsburg "Press" of Jan. 3. The proposed building will cost $150,000, and $5,000 will be added for improvements, and within three months it is expected that the plant will be in operation. The number of men to be employed will be about 500.

The Western Telephone Construction Company is an independent concern, with headquarters at Chicago, and is considered one of the largest in the country. It is the object to establish the main office in Pittsburg, and, while the factory now operating in Chicago will be kept going at its full capacity, the Pittsburg factory will be the largest, and the future additions and extensions will be made in this city because of the cheapness of the fuel and many other advantages afforded. It is the intention of the company to manufacture at least $1,000,000 worth of telephone apparatus in Pittsburg this year.

Large Order for Boilers.

The Babcock & Wilcox Co. have taken from Westinghouse, Church, Kerr & Co. the largest stationary boiler order that has ever been placed. The boilers are for the power plant which the Westinghouse Electric Co. have contracted to build for the Third Avenue Railroad Company, at 218th street and Harlem River, and which is to be constructed by Westinghouse, Church, Kerr & Co. The order covers sixty Babcock & Wilcox forged steel type boilers of 520 h. p. each, or an aggregate of 31,200 h. p. The boilers are to be capable of carrying 200 pounds steam pressure. They will supply steam for compound condensing engines of 64,000 nominal horse power in the aggregate. The power house was illustrated in The Electrical Engineer of January 5. The boilers will be double-decked.

The Zeco Lamp of the Ziegler Electric Co.

ONE of the leading novelties recently placed upon the market for electric lighting purposes is the "Zeco" arc lamp of the Ziegler Electric Co., of Boston, and now being sold in large quantities by themselves and their agents, such as Stanley & Patterson, New York; the Central Electric Co., Chicago, etc. This lamp is of the enclosed type now so universally popular, and is made in a variety of styles, each of which has been worked out with great care. It is not offered as anything radically new, but as the latest and most perfect thing in its line.

A word or two as to the details will be of interest, while the cuts herewith, from Fig. 1 to Fig. 9, show the lamp in all its variations. All of the exposed parts are nickel-plated, and the coils are wound with a special water and fireproof wire. The clutch is a special feature of the lamp and is composed of four knurled rollers, V-shaped, each on an arbor, self-adjustable to any size carbon or to any irregularity. No carbon rod is employed, the current being conducted direct to the carbon by eight brush contacts of bronze. On the direct-current lamp is a simple adjustment in the resistance to take up any variation in voltage, and further adjustment is accomplished by three loops cutting out sections of the solenoid winding. The lamp may be regulated to pass from three to six amperes, as desired, giving proportionate candle power. The same simplicity has been carried out in the design of the alternating current lamp. By a peculiar construction of the reactance coil, the hitherto objectionable features of undue heat and noise are claimed to have been entirely eliminated.

The alternating lamp is designed for operation direct upon a secondary circuit of from 100 to 125 volts. It will burn for about 80 hours with one pair of carbons requiring four and one-half amperes and 75 volts at the arc. The lamp may be used on circuits of either 7,200 or 16,000 alternations per minute. The direct-current lamp is furnished for use on circuits of 110 to 120 and 220 to 240 volts.

It will be readily seen from the cuts that the lamp is of simple and substantial construction, easily taken apart and as readily reassembled. The process of trimming is very quickly gone through. After the globe is lowered, the lower carbon holder is removed by the loosening of a hand set screw at the bottom, and the stub is thrown away. Two turns of the corrugated nut which secures the inner globe allows it to be removed for cleaning.

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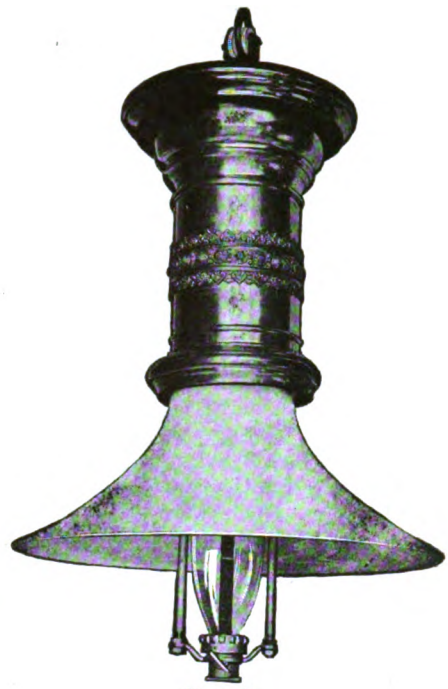
The upper carbon meantime has dropped to a catch or stop. It is removed and fitted into place as the lower carbon. The new upper carbon is introduced and is softly pressed up into its holding sheath. The inner globe and lower carbon holder are now replaced, the outer globe is raised into position and the lamp is ready to be switched on.

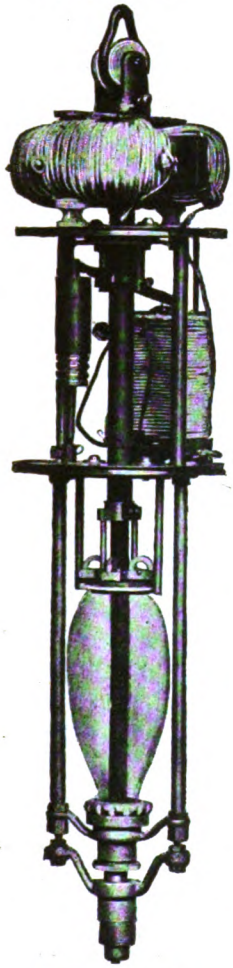
Lamp with Globe Lowered.

Type D.

Type A.



Type C.

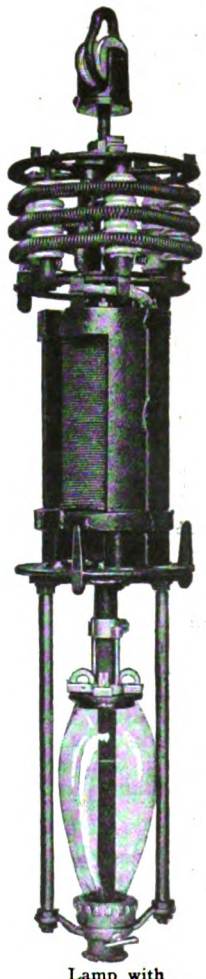


Mechanism of Alternating Current Lamp.

Lamp with Globe and Casing Lowered.

Type B.

Mechanism of Direct Current Lamp.



Lamp with Globe Lowered.

FIGS. 1 TO 9.—TYPES AND MECHANISM OF THE ZECO ARC LAMP.

The carbons used are ½ by 12, and a life of 150 hours is obtainable, but it is better to trim a little oftener. The 220 volt

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lamp burns singly, takes 2½ amperes at 170 volts, and will run 175 hours.

Ferracute Sheet Metal Machinery.

The Ferracute Machine Company, of Bridgeton, N. J., manufacture a full line of presses, dies and other sheet-metal machinery, and for some years past have given their special attention to the electrical business, and have gotten up patterns for several presses for cutting out armature discs, and notching them automatically. They have also paid special attention to a line of heavy punching presses, and embossing presses for making various instruments, and drawing presses for producing gong bells, shells, cups and other deep work.

They are shipping their goods to nearly all of the electrical factories in this country, and have sent many outfits abroad. Their business has increased so rapidly that they have had to add new buildings from time to time, and they are now running full-handed in their new shops, and have recently placed a number of new machines and a new engine in order to give them sufficient power.

They are constantlly watching the development of the electrical trade, and keeping pace with it in a supply of the machines necessary. They have special facilities in their die shops for producing tools for various electrical apparatus. They have just issued a colored poster for general distribution, and have commenced work on a new catalogue which will illustrate and describe over 300 different sizes and kinds of presses.

PHILADELPHIA NOTES

C & C ELECTRIC CO. have moved their Philadelphia office from 633 Arch street to much larger and more attractive quarters at 45 North Seventh street, where the local manager, Mr. William Myers, will be glad to welcome the friends and customers of the company, and attend to inquiries for all their power and lighting apparatus.

A LITTLE FIRE. Fire broke out early, Jan. 11, at 1026 and 1028 Filbert street, Philadelphia, consuming nearly all of the sixth floor which was occupied by Charles Wirt, manufacturer of rheostats and brushes, and F. D. Hazelton & Co., makers of switches and switchboards; doing also considerable damage to the fifth, fourth and third floors occupied by the Electric Protection Co., Charles Wirt and William T. Pringle. Parts of Mr. Wirt's products were made outside this building, therefore no interruption will occur in filling orders. The parties located below the sixth floor are in full operation again.

MR. S. B. WAY has resigned his position as construction engineer for the Electric Storage Battery Co., of Philadelphia, to accept the position of chief electrician for the Imperial Heat & Light Co., St. Louis, Mo.

WESTERN NOTES

WESTERN ELECTRIC CO., of Chicago and New York, has recently issued Bulletin No. 12, T. B. L., descriptive of a tile bolt and lock, and also a screw bracket. The two devices are much in demand. If any of the readers of our paper have not received a copy of this Bulletin, one will be mailed to them upon application.

CARBON CONSOLIDATION. The Chicago "Times" reports on authority that the preferred stock in the new National Carbon Company has been issued with one share of common as a bonus, and that $2,500,000 of the preferred has been disposed of.

NEW YORK NOTES.

MR. W. S. ECKERT, who for some time past has been connected with John A. Roebling's Sons Company, and the Bi-Metallic Electric Transmission Company, has now joined the staff of the National Conduit and Cable Company, whose local headquarters are in the "Times" Building. Mr. Eckert's many friends wish him abundant success in his new departure.

GENERAL ELECTRIC. The General Electric Company has declared a dividend of 11 2-3 per cent. on its preferred stock, payable Jan. 31.

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Department News Items will be found in advertising pages.

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The Electrical Engineer.

Vol. XXVII. JANUARY 26, 1899. No. 560

The Power Plant of the American Soda Fountain Company, Boston Mass.

BY H. W. WELLER, C. E.

INTRODUCTION.

WHEN two years ago the trustees of the Boston Real Estate Trust, owners of the building, placed in the hands of Messrs. Lockwood, Greene & Co., the designing and installing of the above plant, there were comparatively very few combined electric lighting and power plants on the two-wire system operating on 220 volts. However, after carefully considering the matter, it was decided that such a plant offered the best solution of the various problems involved, and it was therefore adopted.

The building, better known as the Tufts Building, had been leased for a term of years to the American Soda Fountain Co. (a consolidation of the various interests in this line), of which Mr. J. W. Tufts is president. It was therefore to be adapted to their particular needs, especially as regards the power and its transmission to the different portions of the structure. The plant is particularly interesting to the electrical fraternity, inasmuch as it is a careful combination of electrical and mechanical transmission, specially designed for the work it was called upon to perform, with due regard to the important questions of first cost and economy of operation.

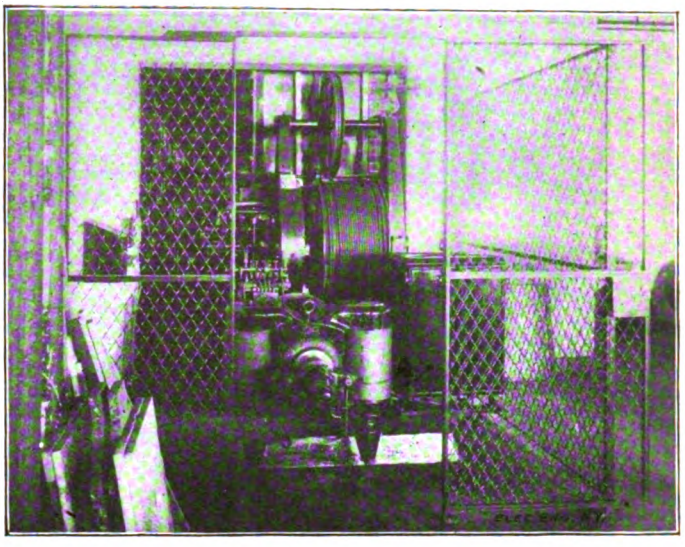
Owing to the number of small machines and tools scattered

THE TUFTS BUILDING, BOSTON.

throughout the building, it was not deemed advisable to install individual electric motors for each of these, especially as their first cost, and that of the necessary wiring, would have been prohibitive.

Briefly, the current is generated in the engine room on the first floor, and distributed to motors on the different floors, which in turn are belted direct to the line shafting in the various departments, suitable clutches and belts being provided, so that sections of the shafting on the various floors can be shut down when required. This makes a very flexible arrangement, and one which in operation has proved perfectly satisfactory.

The advantage of 220 volt motor service is too well known to be alluded to here, but in installing a plant of this kind for both power and lighting from the same generators, it is usual



ONE OF THE ELEVATOR MACHINES ON FIFTH FLOOR.

to run a three-wire system or operate the lamps two in series, each method, however, having objections both in first cost and in operation. As the generators installed give no perceptible change in voltage, with the varying load on the motors, the 220 volt lamps, used in this plant, are run from the same bus-bars, without showing any unsteadiness or flicker in the lights, and the engineers are to be congratulated on the success of the installation.

THE BUILDING.

The building was designed and erected by Messrs. Kendall, Taylor & Stevens, architects, Boston, and has a frontage of 177 feet on Congress street; it is 180 feet in depth and the top of the cornice is 92 feet above the sidewalk. It contains seven floors, the outside walls being of selected hard burned red brick, with cut stone trimmings, while the inside construction is of steel, with fireproof floors. These have a total area of 194,000 square feet, and as the building was designed for manufacturing purposes, the floors, with the exception of the first, were laid out for a safe load of from 250 to 300 pounds per square foot, and these were constructed by the Columbian Fireproofing Co., of New York, under their well-known patents. The first floor was constructed of "Guastavino" tile and cement arches, and filled in with a concrete of cinders and cement. The safe load for a portion of the marble sawing department is 1,000 pounds to the square foot, and the remainder of the first floor, 400 to 500 pounds.

As the site of the building was partly reclaimed from the harbor, it was necessary to "close pile" under all walls and foundations, building a substantial sea-wall and stone and concrete footings upon the tops of the piles.

BOILER ROOM.

The boiler room is 32 feet 6 inches by 36 feet 8 inches and 31 feet high, with a monitor top to the roof, and was laid out for three boilers, each of 200 h. p. nominal. At the present time, two high pressure, horizontal water-tube Campbell-Zell boilers are installed. They are set in one battery, and, in order to comply with the smoke ordinances of the city, and also for economy, are equipped with the well known down draft grates of the Hawley Furnace Company. The gases from the boilers are carried in a steel flue across the rear of the boiler room, and into the stack adjoining. The main damper is automatically controlled by a Spencer damper regulator on the wall of the boiler room. The boilers are equipped with Ashton pop safety valves,

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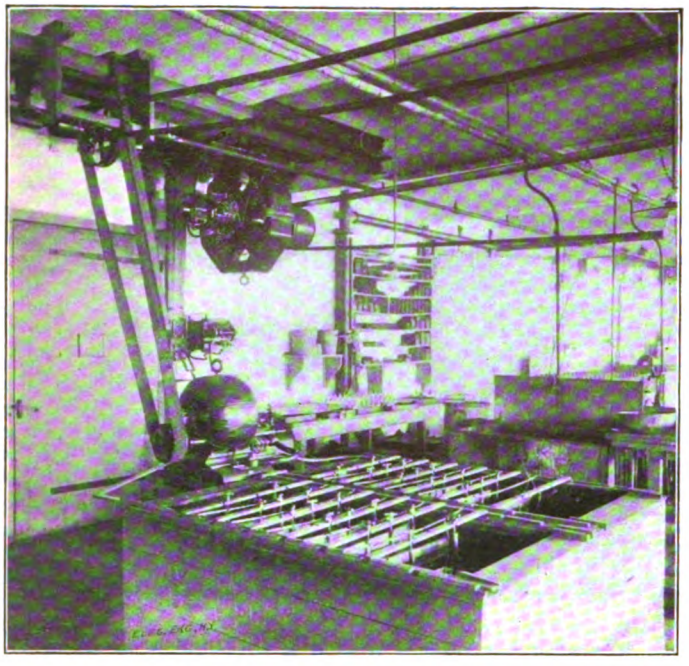
and Reliance water columns, with high and low water alarms, and all the piping is of extra heavy brass. The boilers and flue were supplied and installed by H. W. Weller, engineer, Boston, and the brick setting was done by the Jarvis Engineering Company, Boston.

As all the coal had to be brought through the end of the marble-sawing room, and space could not be spared for any floor tracks, an overhead track was installed with a traveling



A CORNER OF THE PLATING ROOM, WITH EDDY GENERATOR FOR THE BATH.

bucket, by which the coal is brought from the dock and dumped in front of the furnace doors.

The stack is of brick, circular, 5 feet 6 inches, inside diameter, and 150 feet high above the boiler room floor, and is finished off with a neat cast-iron cap.

ENGINE ROOM, ENGINES AND GENERATORS.

The engine room is 33 feet 8 inches by 36 feet 8 inches, and 20 feet 6 inches high, with a monitor roof, and connected with the boiler room by an iron stairway. It contains a compound condensing engine of the well known Cooper-Corliss type, built and installed by Messrs. C. & G. Cooper, of Mount Vernon, O. The cylinders are 36 inches and 16 inches by 30-inch stroke, and the engine runs at a speed of 110 revolutions per minute, steam pressure 100 pounds. The fly-wheel is 14 feet in diameter and very substantial, weighing 35,000 pounds.

The engine is direct connected to a 250 k. w. Crocker-Wheeler multipolar generator. This machine is compound wound, and designed for an output of 1,000 amperes at 250 volts, but will carry an overload of 50 per cent. for a long time without a dangerous rise in temperature. It has eight poles, and six carbon brushes in each set, the brushes being shifted simultaneously by the movement of a single ring when it is necessary to adjust them.

There is also a Westinghouse automatic vertical, three cylinder compound condensing engine 14x14x14 inches by 24-inch stroke, running at 282 revolutions per minute, with a steam pressure of 110 pounds. It is direct coupled to a 125 k. w. Crocker-Wheeler multipolar generator of the same type as the larger machine. The larger unit is installed to carry the power load, while the smaller, which is connected to the same bus-bars, is to carry any excess when the lights are required, in addition to the full power load.

The piping is covered with Magneso-Asbestos non-conducting material, supplied by Nightingale & Childs, of Boston. All the piping is carried underneath the floor of the engine room, which is finished in red and white slate tiles. The piping is designed for high pressure and was supplied and installed by the Walworth Construction and Supply Company, of Boston.

The valves, which are of the Chapman pattern, are controlled from the engine room floor by hand wheels mounted on polished standards.

A handsome gauge board of slate is provided on the wall of the engine room, upon which are mounted six large pressure gauges indicating respectively the high pressure, general service and direct heating system, also the receiver, vacuum, and city water pressures. It has also an Edson recording pressure gauge with alarm attached, and a large nickelled clock. The high pressure carried is usually 100 pounds, the general service 50 pounds, and the heating system 45 pounds. The engine room is also supplied with an overhead traveling crane, running on iron tracks carried on brick supports corbelled out from the main walls. It has a safe capacity of 16,000 pounds, and was built and installed by the Boston Bridge Company.

In the basement of the engine room are located the various pumps, condensers, etc., conveniently arranged, and as they are only a few feet above the tide level, the water for condensing purposes is easily obtained with a minimum of lift, a point of considerable economy in a plant of this character.

There is an outside plunger Blake pump for the hot feed water, the steam cylinder being 8 inches, and the plunger 5 inches in diameter, and 10-inch stroke. It is provided with a simplex valve motion at the steam end and four pot valves on the water end. There is also a Knowles duplex feed pump 6 inches and 4 inches by 7-inch stroke. The condenser is a 500 h. p. Wheeler surface condenser, and the circulating pump is a Knowles three cylinder, the steam, water and air cylinders being each 12 inches in diameter and 10-inch stroke. The feed water heater is horizontal of the Wheeler type and uses the exhaust steam from the pumps.

A gravity oil system is installed for lubricating the engines, the oil being pumped up into the distributing tank by a Deane pump 3 and 2 inches by 5-inch stroke.

There is also a "Magic" oil filter and purifier supplied by Lewis Rice of Philadelphia.

The heating and ventilating system was installed by the B. F. Sturtevant Company, of Boston. The cold fresh air is brought from the outside of the building and forced, by means of a blower, through a Sturtevant heater, and distributed throughout the building. The blast wheel is 10 feet by 5 feet, coupled direct to a Sturtevant horizontal side crank engine, the cylinder of which is 10 inches diameter and 12-inch stroke. The heating stack contains upwards of 11,000 feet of 1-inch pipe, and the hot air is carried from it, in a brick duct in the basement, to the

AN ALLEY IN THE BRASS SHOP, SHOWING MOTOR ON CEILING.

four vertical main brick flues or risers which supply the various parts of the building.

A compressor engine has also been installed in the building, with 7-inch steam and air cylinders, and 7-inch stroke, to sup-

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ply compressed air for operating the pneumatic tools which are used for cutting and drilling the marble slabs.

SWITCHBOARD.

The main switchboard in the engine room was built and installed by Messrs. W. J. Murdock & Company, of Boston, and is of black slate, supported on a substantial iron frame, with free access at the rear for examining the rheostats and connections, but the space is enclosed by gates of open iron work. It consists of four panels, one for each of the generators, one for the power feeders, and one for the lighting circuits.

The panel for the large generator contains a 300 volt Weston direct reading station voltmeter, a Weston station ammeter for 1,500 amperes, a 1,000 ampere magnetic circuit breaker, a generator field rheostat, and a triple pole switch. The smaller generator panel contains a similar Weston voltmeter, a 750 ampere ammeter, a 500 ampere circuit breaker, rheostat and triple pole switch.

The lighting panel has mounted upon it a Thomson recording wattmeter, six double pole feeder switches, and a small direct reading Weston voltmeter. The power panel contains a Thomson recording watt-meter, and 4 large and 2 small double pole switches. The field rheostats are circular in form and were supplied by the American Electric Heating Corporation, of Cambridge, Mass., and are very compact and efficient. The circuit breakers are of the well known I. T. E. type, manufactured by the Cutter Electrical Company, of Philadelphia, Pa. All the switches were manufactured by Messrs. Murdock & Co.

ELEVATORS.

There are seven electric elevators in the building, two for carrying passengers, and five for freight. The passenger cars have a speed of 250 feet per minute, each being controlled by a double traveling shipper, operated by a handle in the car. The motors are compound wound and each is governed by a rheostat, the controller arm being operated by two solenoids placed in series with the shunt field, and these in turn are operated by switches controlled by the shipper ropes. The five freight elevators are each capable of lifting from 6,000 pounds to 10,000 pounds respectively, and three of them have a speed of 50 feet per minute, and are arranged with a double purchase on the ropes. The other two have a speed of 75 feet, and a single purchase on the ropes.

The drums are fitted with two automatic stops, one being the slack cable stop. They have the usual main brakes, and also auxiliary brakes at the top and bottom floors. The safety dogs on the cars are operated by separate counterweights, so that should the weight of the car be thrown off the main cables, the counterweights immediately set the dogs.

All the elevator motors are 20 h. p. bipolar, and were manufactured by the Smith & Hill Elevator Company, of Quincy, Ill., who also supplied and installed the elevators.

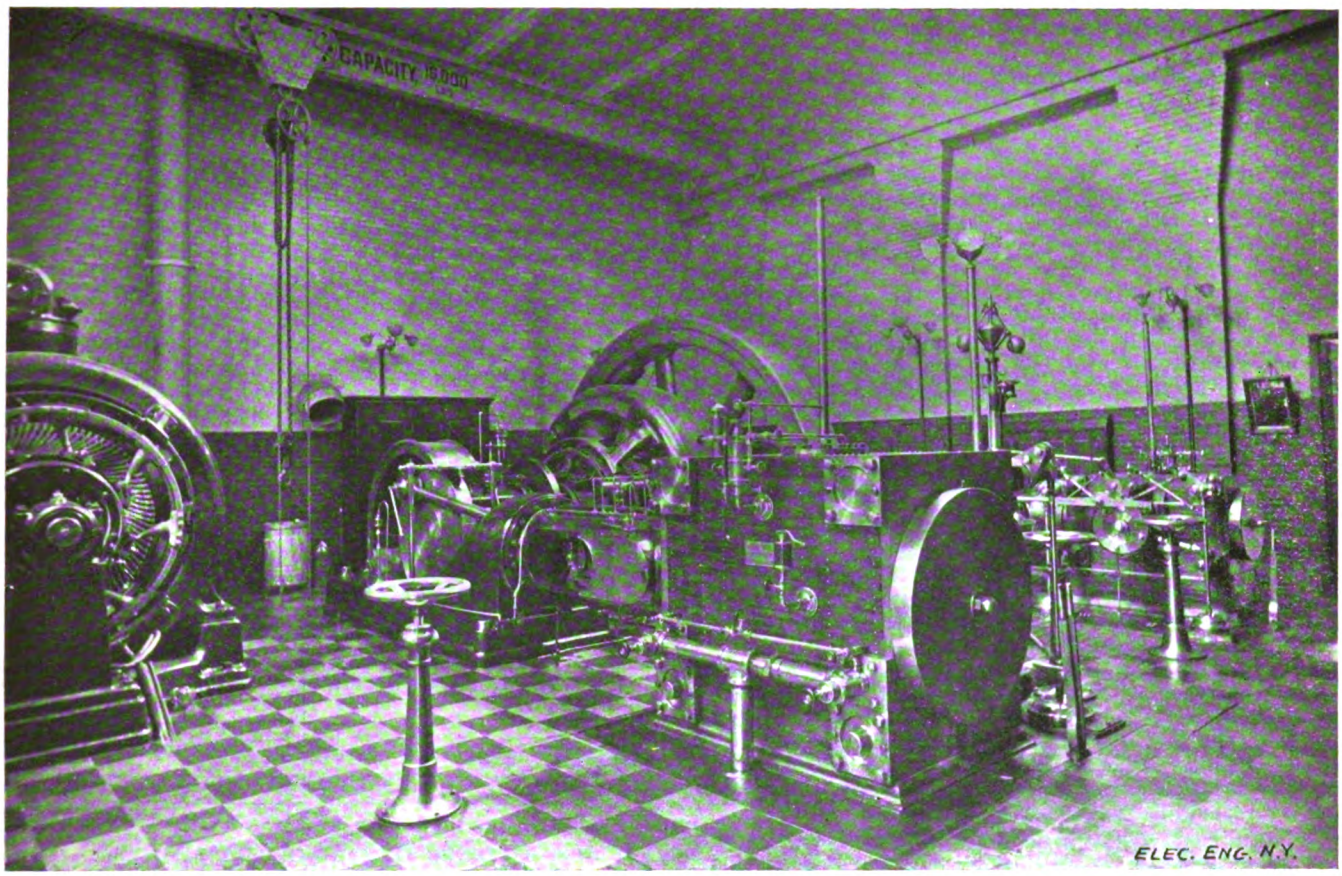
POWER MOTORS.

All power motors, with two exceptions, are of the well known Crocker-Wheeler make. They are inverted and bolted to "I" beams, which are securely fastened to the underside of the ceiling rafters, thus avoiding the necessity of taking up valuable floor space, and the obstruction caused by the driving belts, and at the same time placing them out of reach of interference by meddling employees. The rheostats and controllers are placed on the walls convenient to the motors. The following are the motors installed at the present time, commencing at the top of the building: 7th floor, one 50 h. p. six-pole multipolar motor operating the entire brass shop. The armature is double circuited and handled by four sets of brushes, with special brush holders arranged so that all the brushes can be raised from the commutator simultaneously by one movement of a lever arm. This motor is operated by a standard Crocker-Wheeler controller.

The machine shop, on the same floor, is driven by a 40 h. p. octagon frame motor, with standard Crocker-Wheeler brush holders, and controller.

The copper shop is operated by a 25 h. p. motor of similar type, but this motor is bolted to the floor instead of the ceiling, on account of the coal dust and dirt from the forge being liable to cause trouble with the commutator and bearings.

On the 6th floor, a 50 h. p. 6-pole motor, similar to that in the brass shop, supplies power for the Britannia metal department, and is, like the rest, directly belted to the line shaft.



ENGINE AND DYNAMO ROOM, TUFTS BUILDING, BOSTON. CROCKER-WHEELER GENERATORS AND COOPER AND WESTINGHOUSE ENGINES.

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5th floor. On this floor are located five of the elevator machines, which have previously been described.

In the plating department is installed a 40 h. p. multipolar motor exactly similar to that in the machine shop. It is directly belted to the line shaft, which drives six Eddy 2½-volt plating machines for electrotyping and silver plating purposes. There is also on this floor a 1½ h. p. General Electric new type bipolar motor, with laminated field and extended shaft for a scratchbrushing lathe.

4th floor. On this floor is located one elevator machine.

3d floor. Two 5 h. p. inverted bipolar motors are installed here, one operating the extract department, and the other the testing bed for soda apparatus.

2d floor. The marble department on this floor is operated by a 15 h. p. octagon frame motor of similar type to that in the machine shop. It is also directly belted to the line shaft.

Power for the carpenter shop, tin shop and second-hand marble shop is furnished by a 15 h. p. 4-pole Onondaga motor, running 1,200 revolutions per minute.

1st floor. There is one 10 h. p. inverted bipolar motor, direct belted to the line shaft driving two circular saws in the packing room.

In the setting up and assembling room is one 25 h. p. octagon frame motor directly belted to the metal rolls for rolling down Britannia metal.

In the marble mill on this floor are two 50 h. p. multipolar motors similar to that in the brass shop. One of these is belted to the line shaft operating the marble cutting gang saws. These saws are thin bands of steel in gangs of from 20 to 30 saws, worked back and forth with sand and water, wearing through from 4 to 6 inches of the hardest marble per day and cutting it into slabs of the required thickness. The other motor is belted to the shaft operating the rolling beds for polishing the marble slabs, and also the single marble rip saws. These two line shafts are butted end to end, so that they can be clutched together at any time, in case one motor gives out, thus enabling the other motor to keep both departments going.

THE LIGHTING, ETC.

Distributed through the building are 56 Helios arc lamps, two in series on 220 volts, and also 2 direct multiple arcs, each lamp taking about 550 watts across 220 volts. These lamps were supplied by the Helios Electric Company of Philadelphia. There are also about 1,800, 16 c. p., 220-volt incandescent lamps connected, and operated on a two-wire system. Pass and Seymour porcelain sockets are used, with General Electric new type Edison lamps and T. H. bases.

There is a very complete system of telephones for factory service, consisting of 22 instruments, which was installed by the Whitman & Couch Company, of Boston. In the time bell system are 18 large electric and vibrating gongs, operated off the main lighting circuits, with a sufficient resistance inserted to cut down the electric pressure to about 20 volts. This was installed by Mr. Ross, the electrician of the plant.

The entire plant reflects great credit on the engineers, Messrs. Lockwood, Greene & Co., of Boston, who have installed numerous complete steam and electric power transmission plants in various large cotton mills and manufacturing establishments. The engines were installed by Messrs. C. & G. Cooper and Westinghouse, Church, Kerr & Co., and the pumps, condensers, etc., by the Walworth Construction & Supply Co., who also supplied and erected the piping. The Crocker-Wheeler motors were supplied and installed by Mr. J. Hally Craig, w... Bibber-White & Co., New England representatives of the Crocker-Wheeler Electric Company. The Onondaga motor was furnished by Mr. J. L. Russell, New England agent for the Onondaga Dynamo Company. The A. C. Lewis Company were the contractors for the complete wiring of the building and the line shafting and pulleys were supplied and erected by Messrs. Jones & Laughlin, of Pittsburg, Pa.

The operation of the steam plant is in the hands of Chief Engineer Mr. A. A. Noyes, while electrician, Mr. N. C. Ross, has charge of the generators and motors and electrical installation, and the thanks of the writer are due to these gentlemen, as well as to the architects and engineers, who designed the building and power plant, for the data embodied in the above description.

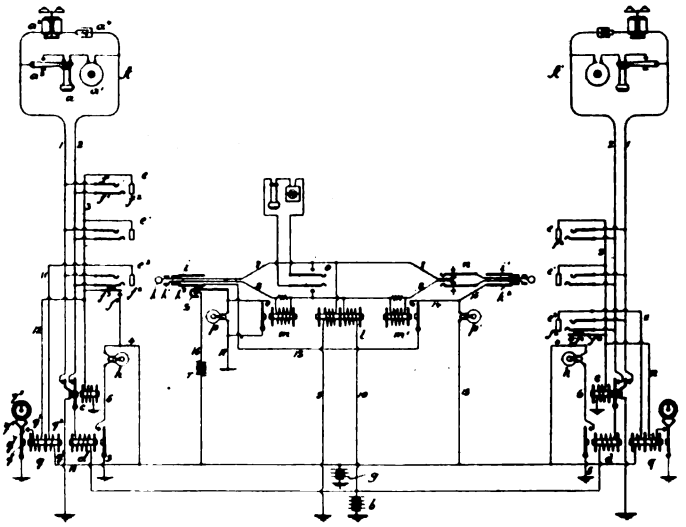
MANILA PRESS MESSAGES are being censored at both ends of the line.

TELEPHONY AND TELEGRAPHY

Scribner's Connection-Counting Mechanism for Telephone Lines.

IN this apparatus, designed by Mr. Charles E. Scribner, each telephone line is provided with an answering jack and a line jack. Pairs of plugs are furnished for uniting lines, of which one member is adapted for use in connection with the answering jack and the other in connection with the line jack, and the circuits of the connection-counting appliance are so arranged that they are brought into operative condition through the agency of registering contact pieces of the answering plug and answering jack only, the final actuation of the appliance being determined in the response to the call at the called sub-station. This arrangement insures the operation of the connection-counter of the call-originating line only. The switchboard organization with which the invention is designed to associate the connection-counting appliance, comprises a line signal for each line, a "cut-off relay" for each line adapted when excited to sever the normal connections of the line signal, a local circuit closed in making connection with the line by means of a plug in a spring jack, including the cut-off relay, plugs, and a plug circuit for uniting lines, supervisory lamp signals, and relays in the plug circuit controlling the supervisory signals.

The process of establishing connection between lines and of



SCRIBNER TELEPHONE CALL REGISTER.

registering the connection in the response of the called subscriber may now be traced. Referring to the figure, a subscriber, as at station A, desiring to secure connection with another line removes his telephone from its switch, whereby the latter is permitted to close the line circuit, and furnish a path for current from battery b through the line relay d. This relay being thus excited closes its switch contacts, completing the local circuit 5 6 of battery g, and brings about the illumination of signal lamp h. The operator in attendance upon that line answering the call inserts plug i into the spring jack and brings her listening key o into position to connect her telephone with the plug circuit 7 8. These acts on the part of the operator bring about the following arrangement of circuits: The plug circuit 7 8, and, consequently, the telephone are brought into connection with line conductors 1 and 2. The contact pieces f^2 f^4 in the answering jack are closed together, whereby a circuit is completed, including wire 4 and a portion of wire 3, through the cut-off relay c, which being excited separates its switch contacts and breaks the connection of line conductors 1 and 2 with earth and with relay d, respectively, whereupon the latter appliance permits its switch contacts to interrupt the current through signal lamp h. The plug seat switch s is permitted to close the local circuit 16 17 through the supervisory lamp p; but since the battery b instantly creates a current through the bridge 9 10, the plug cir-

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cuit 7 8, and the subscriber's line 1 2, in which the supervisory relay m is included, the switch contacts of this relay are closed together and complete the short circuit of lamp p. The sleeve k^2 of the plug is brought into contact with the thimble f^2 of the answering spring-jack.

The operator having learned the order may test the line called for in any suitable way. Having ascertained the line called for to be free for use, the operator inserts plug i' into a line spring-jack e' of the line and operates the calling key n to ring the bell at the station A'. The insertion of this plug in the spring-jack causes a rearrangement of the circuits of the called line in a manner somewhat similar to that just traced for the calling line. The conductor 15 becomes connected with the thimble f^2 of spring-jack e' and with wire 3, whereby a current is permitted to flow, which illuminates the supervisory lamp p' and excites the cut-off relay c of the called line, causing the latter appliance to break the normal line connections with earth and with the relay d. When the subscriber at station A', responding to a call, removes his telephone from its switch, this act permits current to flow from battery b through the wires 9 and 10, plug circuit 7 8, and line conductors 1 and 2 to station A', whereby the relay m' is excited and caused to attract its armature. The movement of its armature connects wires 13 and 14, completing a parallel or shunt circuit about the supervisory lamp p', made up of wire 11, contact pieces f^2 k^2, and wires 13 and 14. Since this circuit has a resistance low compared to that of lamp p', the current through this lamp becomes insufficient to light it, while at the same time the current diverted through the winding q^2 of the counting mechanism excites the magnet thereof and causes the actuation of the registering train. The movement of lever q^4 to operate this train brings contact pieces q^6 q^7 into connection, and thus closes a ground branch from wire 3 through wire 12, including the winding q^3 of the counter-controlling magnet.

After the completion of this circuit the excitement of the magnet is obviously independent of the circuit through wires 11, 13, 14 and 15, being dependent only on the continuance of current through wires 3 and 4, which exists as long as the answering plug i' remains in the answering spring-jack e^2.

It will be observed that the counting mechanism can be brought into operative condition only through the insertion of answering plug i into answering jack e^2 of the line. The insertion of plug i' into a line jack of the line leaves the counting mechanism of that line devoid of circuit connections by which it may be brought into operation. Thus the registering mechanism of a line only becomes operative during a connection and the actuation of that mechanism is determined in the response of the called subscriber to the call signal through the agency of the relay m', controlling the supervisory lamp signal connected with the line.

The Zickler Electric-Luminous Wireless Telegraph System.

AT a recent meeting in Vienna, Prof. Zickler, of Brunn, Moravia, described the system of wireless telegraphy designed by him, which differs essentially from the systems heretofore proposed. The inventor was led to the idea by the contemplation of the enormous distance to which the rays of an electric light projector can be sent, an example of which was the great Schuckert reflector at the Chicago Exposition, the rays of which were observed at Milwaukee, nearly ninety miles distant. One of the drawbacks to the Marconi system, as pointed out by the inventor, is that the signals can be read by any one with a suitable receiver, as the rays are emitted in all directions, and hence no secrecy is possible.

The principle upon which the Zickler system is based is the observation made by Hertz, in 1887, that light rays of short wave length, especially the ultra-violet rays, possess the power of inducing electric discharges. For example, if the discharge knobs of an induction coil be pulled apart until the difference of potential is insufficient it allows the passage of a spark between the terminals, and then if ultra-violet rays be allowed to fall on the terminals, the sparking will at once be re-established. This luminous-electric phenomena is utilized by Prof. Zickler in the following way:

At the transmitting station the ultra-violet rays from an arc light are interrupted in a manner to correspond with the telegraphic signals. These are sent out in the direction of the receiver at the receiving station and permit sparks to pass at that point. These sparks send out electric waves which act upon a coherer, so as to operate a telephone or Morse apparatus, or the sparks themselves can operate directly a bell, a telephone, or telegraph sounder or printer.

As in the case of the Marconi system, spark telegraphy plays an important part here, but whereas in that system the sparking takes place at the transmitting station, in the Zickler system the sparking and its effect is utilized at the receiving station.

The accompanying engraving, Fig. 1, shows the apparatus at the transmitting station. It consists of a powerful arc light, L,

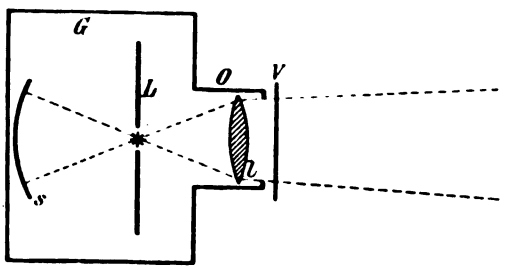
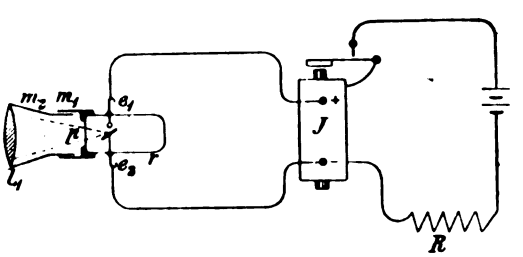


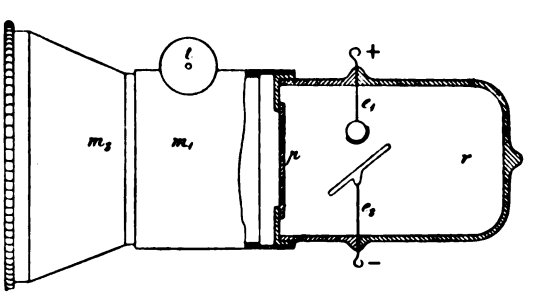
FIG. 1.—ZICKLER ELECTRO-LUMINOUS WIRELESS TELEGRAPHY; TRANSMITTER.

enclosed in a case which can be revolved in any plane like an ordinary projector. Where lenses are employed to concentrate the rays they must be made of rock crystal in order to permit of the passage of the ultra-violet rays. The screen, V, which is placed in front of the opening, consists of one or more glass plates which are operated like the pneumatic shutters of a photographic camera.

As soon as the arc is established the beam is projected through the opening since the visible rays pass through the glass screen, V. The effective ultra-violet, invisible rays, however, are absorbed by the glass plates and no luminous-electric effect can take place at the receiving station. These rays can only pass when the glass screen, V, is removed or opened, upon which the action takes place at the other station. Now by opening and closing the glass screens at proper intervals the ultra-violet rays can be made to correspond to the dots and dashes of the Morse alphabet.

While signaling, only the ultra-violet rays are screened, whereas the visible rays are emitted without hindrance; it will thus be seen that an observer of the beam of light is unable to detect any signal since the beam of light undergoes no change visible to





FIGS. 2 AND 3.—ZICKLER ELECTRO-LUMINOUS WIRELESS TELEGRAPHY; RECEIVING STATION AND RECEIVER.

the eye of the observer. It will be plain, therefore, that the present type of arc projectors can easily be arranged for carrying out this system of telegraphy.

At the receiving station is placed the arrangement shown in Fig. 2, the receiver itself being shown enlarged in Fig. 3. This consists of a glass vessel, r, the front end of which is closed with a piece of plane double parallel quartz plate, p, which is hermetically sealed. In this tube-like glass vessel the electrodes, e_1,

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and e_2, are sealed in. One of these electrodes, e_1, has the shape of a sphere of a few millimeters in diameter; the other electrode, e_2, consists of a small circular disk so placed that a beam of light coming in through the quartz window p strikes it easily. Both electrodes are covered with platinum foil and are separated about ten millimeters from each other. The glass vessel, r, is exhausted to the proper degree or filled with an attenuated gas.

Attached to the front end of the glass vessel is a metallic tube, m_1, having at its front end a funnel-shaped extension with a quartz lens, l_1 attached to the tube, m_2, which can be regulated by means of the thumbscrew t. By this means the rays from the transmitting station can be sent through the quartz window and concentrated into a small oval spot of light. A parabolic mirror can also be substituted in place of the quartz lens.

The electrodes, e_1 and e_2, are connected to the secondary winding of the small induction coil J in such a way that the spherical electrode, e_1, is the anode and the disk electrode, e_2, the cathode. In the primary circuit of the induction coil which need not have a sparking power of more than one or two centimeters, there is a rheostat, R, which allows of a gradual change of the primary current.

For the reception of a telegram, the induction coil is set working and the rheostat operated so that the tension is just insufficient to cause sparks to pass between the electrodes. Then as soon as the opening of the glass screens in front of the transmitting apparatus at the distant station permits the ultra-violet rays to reach the space between the electrodes, the sparks pass between them and cease as soon as the effective rays are again cut off. Thus by operating the glass screen, V, to correspond to the Morse code, signals can be transmitted. The sparks spread in the space about the receiver, produce weak electrical waves which strike a coherer in circuit with a sounder, like in the Marconi system.

Experiments have also proved that the passage of the sparks in the secondary circuit can be used directly to operate a relay of proper construction. A telephone can also be used as a receiver of the signals in this way; these signals can be heard at a distance of over a yard.

It is claimed that Prof. Zickler has succeeded in transmitting signals in this manner to distances up to one and a half kilometers, and he hopes soon by means he possesses for increasing the effectiveness to be able to use this kind of telegraphy for distances which will enable it to be employed for divers practical purposes.

London Police and Telephony.

A special cable despatch to the New York "Herald" says: A week or two ago I referred to the great difficulty of getting in touch in cases of emergency with the Scotland Yard headquarters detective force, there being no telephonic communication with the department. Now a telephone construction company has made Scotland Yard an offer to fit up for various stations all the necessary instruments, and at the end of six months to remove them if they do not give satisfaction. But the Commissioner of Police remains stubborn and refuses to make any change from the slow, A-B-C telegraphic system, of which the police officers are tired, and which one former inspector, writing for the press, calls a rotten and obsolete system. An attempt will be made to force the matter before Parliament soon after it reopens.

School Instruction by Telephone.

Senator Patten, of the Indiana Legislature, is the father of a scheme which proposes to put a common school education within the reach of everyone by telephone, and he is preparing a measure for carrying out his ideas. His plan is to remodel the school system so that there will be in every house a telephone box to be furnished by the State, the wire from each box to lead to some central point in the county or township. The pupils are to use these telephones and thus receive instruction in their studies from the central point. This will do away with the school houses, except the one to be used as a sort of educational telephone exchange.

Telephones in Paris Hospital Beds.

Telephones are to be placed in the wards of one of the Paris hospitals within reach of the bed-ridden patients, so as to enable them to communicate with their friends outside. There will also be an arrangement whereby the telephones may be switched on to a wire connected with a concert hall, so that the performance may be enjoyed by the invalids.

Chicago "Slot" Telephones Not Authorized.

The right of the Chicago Telephone Co. to rent slot-machine telephones, particularly when the lessor demands the usual telephone is denied in an opinion rendered by Asistant Corporation Counsel Edward J. Hill and approved by Corporation Counsel Thornton.

The opinion is the result of the council order inquiring as to the right of the company to rent the slot-machine telephones.

The World's Telephone Statistics.

The German government has had prepared a statistical report of the telephones of the world and which shows that the United States leads all other nations. The entire report affords the basis for interesting comparison and entertaining study and is as follows, although the totals are not exactly in accord with the items:

Countries. Date of Report.	No. instruments in use.	Miles of line.
Sweden (1897)	36,500	74,568
Norway (1897)	20,678	33,481
Denmark (1895)	10,500	9,321
Finland (1895)	7,351	13,049
Great Britain and Ireland (1894)	60,645	83,401
Holland	8,000	4,071
Belgium (1895)	9,227	16,235
Germany (1896)	151,101	147,003
Austria (1896)	21,616	46,575
Hungary (1896)	10,203	17,040
Switzerland (1897)	28,846	47,504
France (1894)	27,736	63,230
Italy (1896)	11,091	13,049
Spain	11,038	14,282
Russia	18,495	40,391
Roumania	750	141
Bulgaria 1893	300	372
Japan (1897)	3,232	5,262
British India	1,601	2,296
French India	89	345
Philippines	452	592
Algiers	335	224
Tunis	200	281
Senegal	50	84
The Cape and Natal	600	1,100
United States (1896)	772,627	805,711
Cuba	1,818	1,181
Canada (1898)	33,500	44,020
Mexico (1896)	9,000	12,807
Paraguay (1891)	500	625
Uruguay (1896)	3,269	8,117
Australia	823	2,300
Total	1,288,163	1,509,200

Telephones for New York Farmers.

The isolation of farmers from neighbors is urged as an objection to life on farms. Neighborhood telegraph and telephone lines have been proposed as a partial remedy, as by these means neighbors could talk with each other daily, no matter what the distance or the condition of the roads. A correspondent in the Hornellsville "Times" tells of a neighborhood telephone line in the town of Jasper, known as "The Jasper, West Jasper and Greenwood Telephone Line." At Jasper village and Greenwood it connects with other lines. The subscribers constructed the line, doing all the work themselves and divided the cash expenses for wire, insulators and instruments into as many shares as there are subscribers. The cost was $14 per share besides the labor and poles furnished. To subscribers the line is free, and others may use it on payment of 10 cents a message. This last furnishes a fund which keeps the line in repair. There are ten subscribers to the line.

LICENSING OPERATORS is the scheme of one bill just introduced in the Indiana Legislature, the fee to be $2, good for one year, and $1.50 each year for renewal.

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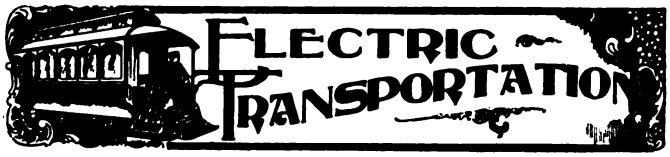

Paris Metropolitan Underground Electric Road.

AS already announced in our columns, work has begun on the new Metropolitan Electric Railway in Paris, and the contract for the entire electric equipment has been awarded recently to the Westinghouse Elec. Co. The system in its entirety will consist of the following lines: 1. From the Porte de Vin-

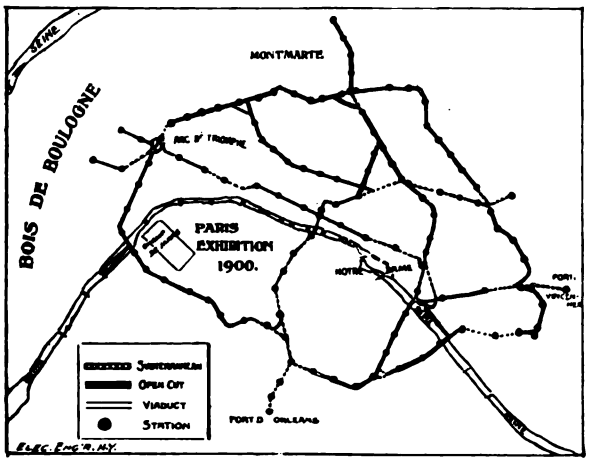

FIG. 1.—MAP OF PARIS ELECTRIC UNDERGROUND.

cennes to the Porte Dauphine. 2. Circular line by the external boulevards. 3. From the Porte Maillot to Menilmontant. 4. From the Porte Clignancourt to the Porte d'Orleans. 5. From the Boulevard de Strasbourg to the Pont d'Austerlitz. 6. From the Cours de Vincennes to the Place d'Italie, by way of the Pont de Bercy.

The concession for the building of the road was granted to the Compagnie Genèrale de Traction on the 27th of January, 1898. The maximum width of the rolling stock is fixed at 2.4 meters, and the maximum height above the rails 2 meters, with a distance of at least .7 meter between the sides of the rolling

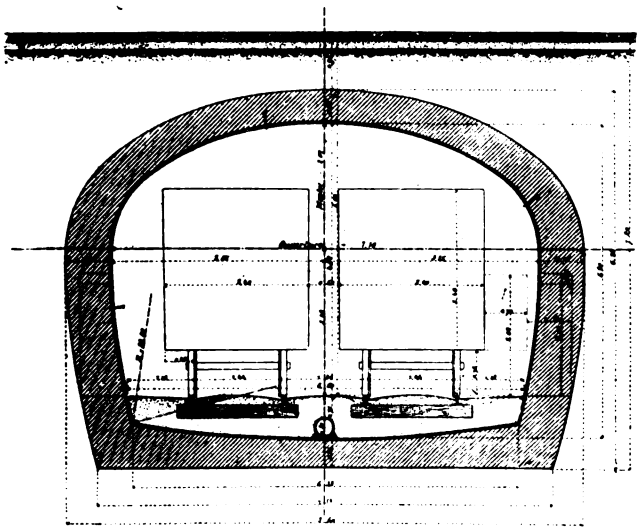

FIG. 2.—SECTION OF DOUBLE TRACK TUNNEL.

stock and the side walls. The width between the inner rails of the two tracks is 1.44 meters.

The City of Paris was empowered to borrow the sum of 165,000,000 francs, the estimated cost of construction. The work of construction of line No. 1 and part of lines No. 2 and 3, respectively between the Place de l'Etoile and the Trocadero, and the Place l'Etoile and the Porte Maillot is now under way, and it is expected will be finished in time for the opening of the Exposition in 1900. The other lines will be constructed later; the routes are shown in the accompanying map, Fig. 1.

The radius of the curves adopted is 75 meters, and these consist of two reversed arcs connected by a tangent of at least

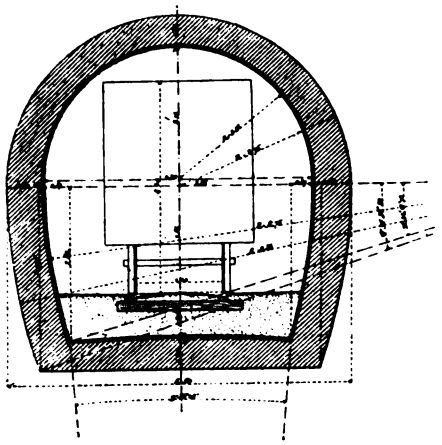

FIG. 3.—SECTION OF SINGLE TRACK TUNNEL.

50 meters length. The maximum grade is 4 per cent. Where two grades in opposite directions meet they are separated by a level stretch of at least 50 meters length. There will be no crossings at grade.

The total length of the lines to be constructed is about 65 kilometers, divided as follows: No. 1, 11 kilometers; No. 2, 23 kilometers; No. 3, 9 kilometers; No. 4, 11 kilometers; No. 5, 5 kilometers; No. 6, 6 kilometers.

The character of the lines in percentage will be as follows:

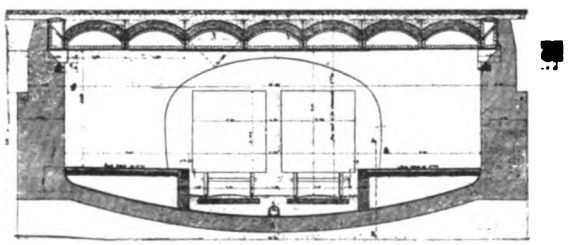

FIG. 4.—STATION WITH METALLIC ROOF.

Underground, 70 per cent.; open cut, 14 per cent.; viaduct, 16 per cent.

The whole system will be double track. Fig. 2 shows the section of the underground road with curved roof. The interior width is 6.6 meters at the level of the rails and 7.1 meters at the spring of the arch, which is 2.43 meters above the level of the rails. The total outside width of the tunnel is 8.6 meters. The interior height at the centre is 5.2 meters and the total external height 6.29 meters; where at certain points the two tracks require to be separated the section shown in Fig. 3 has been adopted. Where cuts are employed they will be covered by the metallic roof and the street pavement relaid above them.

The stations will have two parallel platforms 75 meters long, thus allowing of a train of six cars, the length of the car adopted

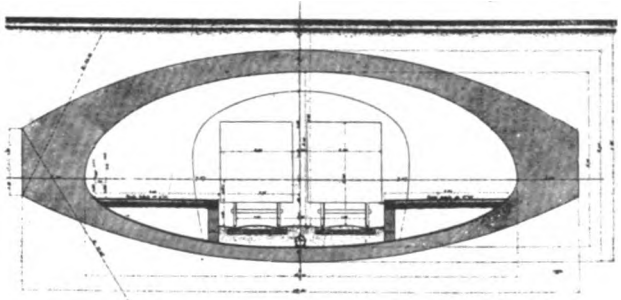

FIG. 5.—VAULTED STATION.

being 12 meters. These platforms are four meters wide, and the distance across from one to the other is 5.5 meters. The external width of the station with metallic roofing is 13.5 meters, and the construction of such a station is shown in Fig. 4, while

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Fig. 5 shows the construction of an arched underground station of concrete.

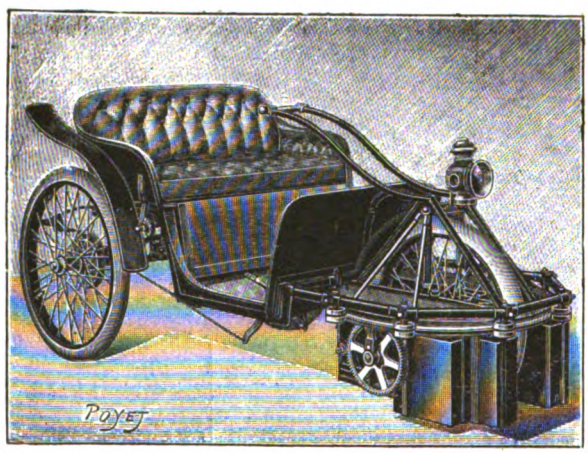
As above stated the estimated cost of the work is 180,000,000 francs, that is, about 2,800,000 francs per kilometer ($875,000 per mile). The City of Paris undertakes to carry out all the subterranean work, cuts, viaducts, platforms, etc., while the operating company bears the expenses of the roads leading to the stations, entrances and exits of stations.

The concession is granted for a period of 35 years. At the expiration of this time the city becomes surrogate to all rights of the company in the roadbed and its accessories, especially the electric power houses. The city reserves to itself the right to acquire the material and the equipment of the stations, workshops, office fixtures, etc., and entrances to stations at an appraised valuation, and will have the right to acquire the entire system by purchase after the 31st of May, 1910.

The following will be the rates of fare for the Metropolitan District: First class, 25 centimes (5 cents); second class, 15 centimes (3 cents). In order to provide for the sinking fund for the redemption of the 180,000,000 francs at 3½ per cent. a traffic of 126,000,000 passengers or 2,000,000 per kilometer will be sufficient. This estimate is not considered high, and, in fact, it is probable that it will be very rapidly reached, in view of the fact that the Metropolitan roads of London, Berlin and New York carry 3,000,000 passengers per kilometer.

The Milde Electric Voiturette.

ONE of the interesting electrical novelties in automobiles recently shown at Paris is the Milde "voiturette," here illustrated. It will be seen that the batteries and motor are mounted on a separate truck or platform on the forepart of the tricycle, surrounding the front wheel and suspended from the encircling frame or shafts attached to the body. The batteries are 15 Fulmen accumulators, type B, in three groups, each cell with 5 plates, of 85 ampere-hours' capacity, and delivering current at 25 volts to a series wound motor taking from 500 to 600 watts. The armature is geared in the manner shown to the central wheel and at 2,000 revolutions per minute gives a normal speed of 15 kilometres an hour. Steering is effected by the handle bars, supported by four posts, which turn the whole front truck bodily



THE MILDE ELECTRIC VOITURETTE.

within the shafts, with the aid of the guide wheels bearing on the platform that carries the mechanism, etc.

The controller is placed under the seat and is operated by the handle seen at the right side of the carriage. It throws the batteries into various groupings and cuts in and out resistance from the field of the motor, so as to obtain different speeds and outputs. There is one pedal just within the dashboard to cut down the current quickly for slackening speed and another which actuates a mechanical band-brake on the rear axle.

The voiturette can, it is stated, make a trip of 60 to 70 kilometres (35 to 45 miles) without recharging. Its total weight with two passengers is 440 kilogrammes (950 pounds), of which 140 k. g. is for the fares. The load of 26.4 tons-kilometres is carried at an output of 127 watt hours per ton-kilometre, and at a cost of 3 francs per day, including recharge. The price is 3,000 francs, or $600, which puts it well within the reach of a great many people of but moderate incomes needing vehicles for business or pleasure travel. One criticism on the rig that might be offered is that the mechanism and batteries should be better housed from the weather. The designer of the carriage is M. Greffe.

Steam and Electric Roads in Ohio.

A special despatch from Columbus, O., says: The Pennsylvania system is experimenting with the use of steam motors on the western branch lines, and in a few days the Pan Handle will receive from the East a motor car for experimental purposes on the Springfield branch running from Vienna to Springfield, O., a distance of 19 miles. Tests thus far are understood to have been successful and to have demonstrated that a combination engine and coach is better adapted for branches of steam roads than electricity, while much more economical than steam trains, where travel is light. The Detroit & Lima Northern is also having built a similar car for branch lines, while other steam roads throughout the State are giving the system a thorough investigation. The action is to meet competition of electric roads.

The Trolley in Mexico.

The work of converting the street railway system of the City of Mexico into electric lines is progressing rapidly. A force of more than 500 men are employed in the work. The line of track is now completed from the suburb of Guadaloupe to the Zocalo, which is adjacent to the National Palace, and the trolley poles have been erected from Gamto de Peralvillo, to Guadaloupe. The trolley poles for several other of the suburban lines have also been placed in position. The structural iron work at the new power house is nearly completed and the sub-foundation is all finished. About 25 miles of the system will be equipped and in operation in a few months.

The Government Investigation of Municipal Plants.

ABOUT two years ago, at the desire of various bodies and individuals interested in municipal ownership. Mr. Carroll D. Wright, Commissioner of the U. S. Department of Labor, began an elaborate inquiry into the operation of municipal lighting plants. Early in 1896 the plan was outlined as follows in the columns of The Electrical Engineer: The subject of municipal ownership of gas and electric light plants is proposed as a subject for joint investigation by the National Department of Labor and the Bureaus of Labor Statistics in the several States, the agents of the National Bureau to confine their inquiries to States which have no bureaus of statistics. The inquiry will be made in all cases upon uniform blanks and according to uniform methods. This will add greatly to the value of results and their convenience for investigators, because it will make it possible to make easy and exact comparisons. Every electric and gas-lighting plant in the United States which is owned by the municipality will be reported upon, and a sufficient number of private establishments will be included to afford a basis of comparison between the two classes. The mere difference in price of lighting is often relied upon in these controversies to decide the merits of the two systems, but many other elements will be considered in the proposed inquiry. Full statistics of the cost of plant, the interest on plant, the cost of materials, the wages paid, the cost of superintendence and the quality of lighting furnished will be given. The balance sheet for public and private establishments, indicating whether the public establishments pay a real profit, make up a deficiency from taxation, or pay a nominal profit by ignoring the cost of plant and bonded indebtedness incurred for its establishment, will be presented in each case. These results, tabulated according to uniform methods, will be sent to the National Department of Labor, according to the plans of the Executive Committee, and will there be consolidated into a complete report

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5757 Sheet 2. | LIGHTNING PROTECTION. | B.

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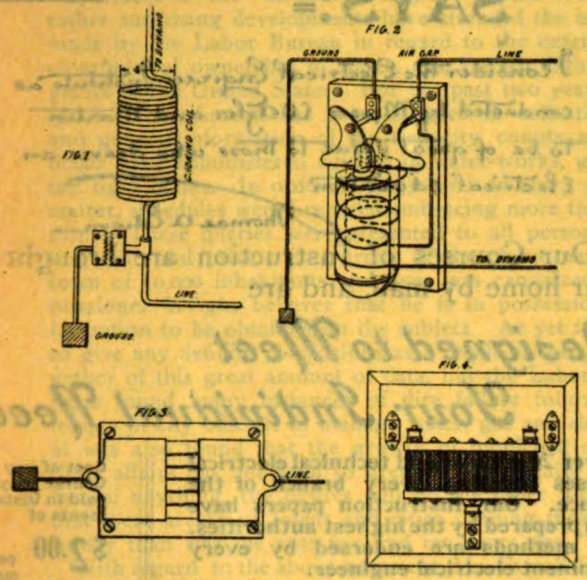
Several peculiarities of lightning traversing a conductor are taken advantage of to protect electrical machinery connected to the same conductor, as it will jump a considerable air gap when opposed by an inductance due to its high frequency. The feeder or conductor is wound around a 4 inch mandril about 20 turns, see Fig. 1. This will offer sufficient inductance on



the line side, and near this choking coil one side of the air gap is connected, the other side being connected directly to the ground. The proper opening for this gap depends upon the normal line potential; 1/32 inch for first 100 volts, and 1/64 inch added for each successive 100 volts on the line, is a rule that comes near practice. It is evident when the spark has jumped the air gap, that it has lowered its resistance so the line current can follow. The Thomson arrester, Fig. 2, has the air gap flared, and also in a magnetic field made by the flow of the main current through the coils of an electromagnet. As the arc is repelled out of this field it becomes longer and more attenuated until it is extinguished. A number of these magnets are in series and multiple gap, and laminated magnets are used on high potential alternating current lines.

Continued on 5757, Sheet 3.

5757 Sheet 3. | LIGHTNING PROTECTION. | B.

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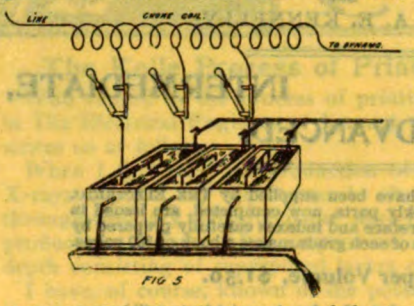
Continued from 5757, Sheet 2.

Another principle used is that while a high potential discharge can break over a number of air gaps in series, a continuous current following cannot maintain this discontinuous arc. The construction of the arrester employing this principle, see Fig. 3, is to have the ground and line terminal brass plates separated by some hard wood, then with a hot iron there are parallel grooves burned leading from one plate to the other. This is enclosed and the potential discharges leak through these carbonized serrations, but the main current cannot follow.

Another multiple gap type is that known as the Wurts arrester. The arcing surfaces are formed of milled cylinders made of non-arcing metal spaced 1/64 inch apart. Generally seven are employed giving six spark gaps, see Fig 4. When the lightning jumps these gaps the following arc is interrupted by the whiff of non-conducting oxide made by the passage of the lightning. As the difference of potential between line and ground is due to the line insulation, another means of protection can be afforded where one side of the system is grounded, by introducing a leak between the line and the ground so that the line can be maintained at the same potential as the ground. This leak is connected between the overhead line and ground when there is danger, see Fig. 5, and consists of a water tank which is supplied by a stream of water. The overhead wire terminates in this tank in several arc light carbons, and there is a grounded plate in the tank; three of these are put in series with choking coils placed between two of them, so that lightning cannot pass into the station. The current wasted is only a few amperes if the water is kept cool. By means of switches this leak can be taken off when danger is past.



Lines are also protected by having a barbed wire run above them over the poles, and grounded every five poles. This brings the electric potential of the earth above the line.

In a multiphase high potential system the lightning arresters to each phase should be grounded separately and at some distance apart, to introduce sufficient resistance between them, so in case of simultaneous action, a cross carrying sufficient current to destroy the arrester could not be formed.

Arresters should be placed along the line, at the top of hills, changes in direction of the line, sub-stations, transformer banks and the stations, which are all danger points. The ends of feeders and line circuit breakers are also points that need protection, as in railway conductor systems. Any consumption device possessing capacity is especially liable to damage by lightning. The placing of lightning arresters at a fixed distance apart independent of the above consideration, is not good practice. Any lightning arrester is inoperative unless the ground to which it is connected is good. For making station grounds, see 5757, Sheet I.

To be continued.

6100 Sheet 12. | TESTS OF STATIONS FOR ECONOMICAL OPERATION. | B.

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In a lighting station the economy of output at maximum load may be neutralized by not keeping the losses at low loads at a minimum. There is generally a selection in a station, of methods of operating the boilers and units to carry all-night load after the peak has been passed, and the all-day loads, and in order to determine the least coal consumption, the tests are carried out in the following way: Divide the 24 hours' coal consumption by 24; this will give the average hourly consumption. Have the fires under the boilers for the run average, and steam at full pressure, and all coal cleared away from the boiler room floor. Dump the weight of coal that represents the one-twenty-fourth part of the day's supply and read the wattmeter on every main circuit, giving the output of the station. If volts and amperes have to be read for watts, take readings every ten minutes, Get in the habit of reading the amperemeter the instant you look at it; do not wait for a change in reading before noticing output, which is the usual practice.

The amount of water used by the boiler should be known. The water meter supplying all boilers should be read at the time the first of the weighed coal is fired; also the wattmeters in the stations, as well as the time of firing of the coal. The station is run as usual, and if there is any steam

5880 Sheet 4. | EDISON CHEMICAL METER. | A.

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In three-wire systems two shunts are used, one on each side of the system. It is found by experiment that when a current passes between two zinc plates immersed in the solution of sulphate of zinc of the proper density, that 1,224 milligrammes of zinc will be removed from one plate and deposited on the other for each ampere hour of current that passes between these plates.

In the old style of meter the lost weight of the positive plate multiplied by 975 and divided by 1,224 will give the actual ampere hours passing through the main shunt. In the new style of meter for every ampere passing through the meter one milligramme of zinc is transferred in the bottle of No. 1 meter. It takes two ampere hours in No. 2 meter to transfer one milligramme. A No. 4 meter takes four ampere hours, and so on. Usually each station has a bill constant by which it multiplies the loss in milligrammes which gives the value in dollars and cents of the current consumed.

Zinc when immersed in an electrolyte will oxidize, due to the air in the solution. This oxidizing is determined by each station by immersing

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covering the entire United States. The features of this report will be furnished to the various State bureaus for use in their own reports, with such additional detail as they may think it desirable to furnish for local uses.

The inquiry has been carried out with considerable pains and effort, and the result is thus reported by the Washington correspondent of the "Brooklyn Eagle:" "Some interesting and rather surprising developments have attended the investigations made by the Labor Bureau in regard to the extent and effect of municipal ownership of water, gas, electric light and power plants in the United States. For the past two years the whole force of this bureau has been engaged in collecting statistics and general information of the way city, county and town officials have administered control of water-works, gas and electric light plants. In order to get posted on every phase of this matter, schedules were prepared embracing more than 850 questions. These queries were presented to all persons interested in public and private enterprises of the above nature. Every town of 10,000 inhabitants and over was canvassed, and Commissioner Wright believes that he is in possession of all information to be obtained on the subject. As yet it is too early to give any definite conclusions as a result of the gathering together of this great amount of data, but the Labor Bureau experts found many instances of dire failure following the attempts of city officials to manage water, gas and electric works. It was also found that the growth of municipal ownership in these affairs has not been so great as is generally thought. In fact, if anything, the figures will go the other way, and show that there are fewer towns and cities running these enterprises to-day than was the case five and ten years ago.."

With regard to the above statement, Mr. Carroll D. Wright, in answer to our inquiry, writes us under date of Jan. 19 from Washington: "We have given no forecast of facts, nor any advance summary, nor can we do so for some months to come. The field work is completed, and the tabulations are going on. When the report is entirely completed and ready for the printer we will allow newspaper representatives to make an abstract of it."

Improved Methods of Fire Protection.

TO correct a misapprehension as to part of my recent remarks since then widely copied from your journal on the need of improved fire protection, I would say that my article was in no sense intended as a criticism on the rank and file of New York firemen. For these employees of the city are, to my knowledge personally, as brave and attentive to their duties as those of any city in the country; and, excepting the Brooklyn school teachers, they are among the most poorly paid, considering their long hours and the dangers of the service; but the higher officials have sat in their soft-cushioned official chairs complacently drawing their salaries for several years and have watched twenty-story buildings springing up all around them, without in any way exerting themselves to provide means to fight fires under these changed conditions. Well, down by the sea, where the gentle zephyrs blow, there are to be found some little animals—almost vegetable in their habits—seated in their soft, muddy beds awaiting the tides to overwhelm them. Scientifically they are known as "Clamus Domestica."

The aim of my article was to have placed under the control of our firemen an efficient, up-to-date fire-fighting system. Our firemen will be found willing and enthusiastic in the performance of their duties—even at the risk of their lives, but when repeatedly they find themselves helpless to fight the fires beyond the reach of their little toy apparatus, they will soon lose heart and all pride in their calling.

No army can be kept in good discipline and be enthusiastic fighters who are continually defeated in battle through no fault of their own.

Ground rents are too valuable in this city for seven-story buildings—the limits of our little fire engines.

The capitalist wants the best returns for his investment, and scientific inventive talent has shown him how to get it in modern building construction. And the tenants prefer to be up and away from the noise of the streets, where there is plenty of sunlight and fresh air.

To limit the height of buildings against the wishes of these two great elements that go to make up a city, because certain city officials are not progressive, would be a sad travesty on modern municipal government. JEAN WETMORE.

New York City, Jan. 19, 1899.

The Kolle Process of Printing by X-Rays.

With regard to the process of printing by X-rays, described in The Electrical Engineer of January 19, Prof. Elihu Thomson writes us as follows:

When I first tried the production of multiple impressions by X-rays in 1896, my object was to show that the rays getting through ordinary sensitive paper were not exhausted, but might produce impression after impression through a considerable depth consisting of superposed layers of sensitive film.

I have, of course, known of the possibility of printing in this way from my first experiments, but have made no endeavor to develop any process of the kind. The process as worked out by Izambard, and extended by Dr. Kolle, is certainly very interesting, and may, I think, have some practical application where the peculiar conditions under which the process can be carried on are valuable, as in the production of a number of copies of secret documents. It might, possibly, have value in the reproduction of copies exactly like the original, in cases where the ordinary photolithographic processes would be too expensive on account of the limited number of copies needed. I hardly can see in it, however, any great promise as replacing ordinary printing on a large scale. I think, indeed, that the speed of printing would be largely neutralized by the operation of developing, fixing and drying, as well as by the cost of the paper.

ELECTRICAL TESTING FOR TELEGRAPH ENGINEERS. By Elton Young, M. I. E. E. Published by The Electrician Printing & Publishing Co., London, 1898. 264 pp. Price, $4.00.

This book contains numerous interesting chapters on the subject of telegraph testing. It embraces the entire subject, devoting considerable space to submarine work, and not speaking at all of telephone cables, which is to be regretted. In the introduction the author describes the various measuring instruments without, however, giving any illustrations, and but mentioning the new Deprez-D'Arsonval galvanometer. In the chapter on insulation, the author describes a method of finding the insulation resistance of a cable by means of the loss of charge and shows that this method can only give approximately correct results, and also how the small errors which generally creep in might be avoided or balanced. Measurements with electrometers are not given at all, the author probably recognizing the subtleness of the Kelvin instruments and the extreme sensitiveness of the newer and simpler types. Considerable new material is to be found in the chapter on "Capacity Measurements," and Mr. Young shows that the method proposed by Muirhead is not very well applicable to long cables. He proposes a very simple method by means of which if the insulation resistance is taken into consideration the capacity of the cable can be found. He devotes considerable space to the fault determinations. Old and new methods are fully described and many useful hints are given, such as the introduction of a milliamperemeter in the cable leg of the Wheatstone bridge. The author does not specially recommend any particular galvanometer for cable measurements. In conclusion, he gives numerous valuable and highly satisfactory tables and brings to a close a volume which is timely, accurate and complete.

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The Northwestern Electrical Association.

THE successful conclusion of the meeting of the Northwestern Electrical Association indicates unmistakably that this society has a real mission, and it is to be congratulated on its proud boast of having the largest membership of any electrical society of a similar character in the country. If we were asked to state a reason for this success we should say that it is due to the fact that the association embraces within its membership many small stations in a particular section of the country where the conditions existing are in many cases similar, and where more or less direct comparison can be made between one station and another. But it is not without misgivings that we note a slight indication of discord arising, due to the fact that the association is widening the territory from which its membership is drawn. This was made apparent in the discussion of the resolution to assess members for the purpose of maintaining a watch on legislation affecting electric light companies in one particular State. It was pointed out by some of the members that it was not the proposition of the society to aid the members of any particular locality, and the result was that the resolution was modified in accordance with that view. This slight indication, however, points to the fact that in spite of national and regional associations there is still need for State associations, and we believe that they will increase as time passes. Still, we should be glad to see the Northwestern Association attempt to solve the State problem in its own way.

Among the papers read at the meeting there was none that brought out more discussion than that by Mr. Debell on the subject of "Rates." There may, of course, be conditions under which a flat rate may serve the central station better than a meter rate, but, when, according to the testimony of one of the members, the light output was doubled by putting meters on the circuits, there can be no question as to the ultimate method of current charge. Of course, this conclusion was reached years ago by many station operators, but it still seems necessary to point out the lesson, and it is well that the association took up the subject and threshed it out again, as it will help to keep many small electric light stations out of the hands of receivers, and place them on a dividend-paying basis.

Mr. B. J. Arnold's paper on "The Trend of Central Station Design" was an excellent survey of the present systems of current generation and distribution and of their probable evolution. While Mr. Arnold looks to the alternating current as the distributing medium of the future, he believes that it is still behind on some points, and that it falls short in the operation of printing presses and elevators. So far as the operation of the latter is concerned we believe that this objection is not so strong as it was but a few years ago. Take the case of St. Louis for example, where there are quite a large number of elevators operated by alternating motors, and, so far as we know, with success. Still Mr. Arnold is in a hopeful mood for the alternating current, and goes so far as to express the opinion that the connecting link between the present direct-current station and the future alternating is the combination of alternating-direct current generators, which can be readily converted to alternating when the time seems ripe for it.

Mr. Arnold's assertion that the use of the storage battery has not yet entered the domain of "established practice," we take it is meant to refer to this country alone; but, putting even this construction upon it, we cannot agree entirely with Mr. Arnold. The storage battery to our mind is certainly entitled to be looked upon as good practice in all stations where its use is warranted, and there are, at least in connection with direct current stations, either for lighting or regular power service, probably few instances where the installation of a storage battery would not be conducive to economy. It will only be a short time probably before Mr. Arnold will find it necessary to revise his opinion on this point.

Who Shall Build the Automobiles?

ONE of the oldest of the artistic trades and handicrafts is that of carriage building. It has grown up through many centuries, and has formed a separate industry with workmen, traditions and reputations of its own. Probably its prosperity was at the height during the stage coach days, but it is not unlikely that the growth of private wealth has maintained it on the old plane of activity during the whole of the century now closing. Although the railroad companies did not long go to the coach builders for their cars, there was an enormous increase in the number of private vehicles of all classes, and thus the loss of the stage coach was not seriously felt by the carriage builders. At the present moment, however, as the century closes, an entirely new prospect opens up, and one is led to conjecture whether the changes in carriage building may not become so revolutionary as to cause the industry to pass into new hands, unless the former directors of it are alert enough to adapt themselves promptly to the latest conditions. It is the automobile that is the instrument of this new departure, and the outward sign of a change as great as that from bows and arrows to breech-loaders and machine guns.

To state the case broadly, the carriage builders of the past have all been, practically, workers in wood. Now, while it is possible that not a little wood enters into the composition of an automobile, it is easy to picture such vehicles, and good ones at that, into whose construction not a particle of wood enters. The modern automobile is a thing of steel and rubber tubes, while its body may preferably consist of aluminum, light sheet steel, and a few trimmings not necessarily of leather. The automobile embodies other problems than those of a vehicle that is hauled. It lifts itself into speed from a dead rest; it is steered within itself; its motive power is a matter of mechanism, and the questions that arise at each step are radically different from those relating to the carriages of our fathers. How many carriage builders are there to-day who have given any proof of their desire and intention to head the new procession, and to be the chief beneficiaries of the new tendencies? We are constrained to answer, not one so far as we know. Some of the carriage builders are making wooden bodies to fit the running gear of various automobiles, but, as we have suggested, that is a precarious tenure, with little promise of permanency in the new art.

It does look, at this moment, as though a new crop of manufacturers must come to the front, recruited, perhaps, to some extent by the more enterprising of the old carriage builders, but consisting very largely of concerns trained in the fields of bicycle building and electricity. The automobile is very much on the lines of the cycling machine, and, so far as city traffic goes, with which the new work is beginning, it is evident that electricity is to be the dominant element for many excellent reasons. Nearly all the automobiles exhibited this week at the cycle show are electric, and all the marked improvements are being made along electrical lines. The only automobiles plying for hire in this city are electric, and it is difficult for love or money to engage one for the evening later than ten o'clock in the morning.

When wooden ships made way for the iron steamer, a new race of shipbuilders at once came to the front, and now that wooden vhicles are yielding place to automobiles compounded of metal and rubber, another new breed of captains of industry

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with other skilled artisans bid fair to make the art especially their own. It will be very interesting to see the evolution work its way out.

The Latest Keely Exposure.

WHILE one would rather draw the veil of oblivion over the doings of the late John W. Keely, still the facts which have come to light since his decease demand some notice. While there is probably no doubt that Mr. Keely had sincere admirers, and among them many who believed in him and his theories, all whose opinions are entitled to consideration saw in Mr. Keely's mysticism a cloak for methods which would not bear the light of investigation. That this view was to a large extent, if not absolutely, justified, is now made apparent by the revelations which have recently followed upon the dismantling of Mr. Keely's Philadelphia "laboratory."

It has long been held that all the experiments performed by Mr. Keely were carried out with compressed air as the motive power, although no one had heretofore been able to prove that fact. At one time we were almost inclined to believe that Mr. Keely operated by the aid of alternating currents utilizing the now well known phenomena of repulsion. All doubts, however, seem to be set at rest by the discovery of buried reservoirs designed to withstand heavy pressure and numerous outlets in the shape of fine tubing for the conveyance of the pressure to the apparatus exhibited to visitors, with the accompaniment of numerous trap doors, false floors, etc. A committee of scientific gentlemen and engineers, among them the well-known electrician, Mr. Carl Hering, of Philadelphia, who witnessed the dismantling of the laboratory, express themselves in no uncertain terms as to the means employed by Keely in the carrying out of his experiments and in the operation of the so-called Keely motor. While, as stated above, we have never believed that Keely was in possession of any of Nature's secrets, it is gratifying to know that the mystery surrounding his operations has been removed, and that the Keely motor is now definitely a thing of the past.

Bridges or Tunnels.

THAT Brooklyn and New York, not to forget metropolitan districts further out from the centre, must be more closely united in a physical way, is one of the obvious facts of the time. Mayor Van Wyck has been advocating numerous bridges, but there does not seem any good reason why half a dozen tunnels would not do as well, leaving the tides to run freely and offering no obstacles to navigation. In Boston, the subways have worked a wonderful development of over 100 per cent. in the travel, and the system there bids fair to undergo a great expansion. The people have become accustomed to underground travel by electricity, and like it so much that they ride twice as much as they did previously. With electric lights, electric traction, electric elevators and electrical ventilation, underground travel is a very different thing from what it once was, and the objections to it daily lose their force or pertinence.

Mr. J. V. Davies has recently lectured before the Brooklyn Institute on the proposed Long Island Railroad tunnel between Atlantic Avenue and lower Manhattan, and has described its proposed construction and equipment. Not the least part of his argument lies in the following utterance: "The growth of our city requires and demands increased facilities for transportation, and particularly to suburban districts. Our Mayor is now advocating bridges galore, and no bridge can possibly be of the immense service to suburban New York that this tunnel scheme will be. Add also that in this case the city is not asked to expend any part of its wealth and thereby add anything to the great debt limit we hear so much about. The Long Island Railroad will construct the tunnel if only the necessary permits are granted it to drive a tunnel deep down below the surface. The cost of this tunnel, with all its advantages, and reaching all the way from the North River to the junction with the Long Island Railroad at Flatbush avenue, will be not over two-thirds of any bridge from river front to river front of the East River, and having none of the advantages this route has for those outlying districts of our great city." These are arguments not to be lightly put aside. Such tunnels might well be the precursor of a system which New York City will certainly need in ten years, and whose absence nothing but the splendid service of the Metropolitan Street Railway Company enables us to overlook complacently. We describe and illustrate in our present issue the new Paris underground, for which the Westinghouse electrical interests have secured the contract, and would point out that Paris now joins London in securing the benefits of underground electrical travel, while the road itself exemplifies also the work of the Boston subway and the New York elevated. And yet Mr. Russell Sage has the effrontery to state that one of the foremost men in the electrical field has advised him to stick to steam!

Cleansing Havana.

NOW that we have undertaken to put Cuba's house in order before we turn it over to her own people, it becomes more apparent every day that the place at which to begin the house cleaning is Havana. For hundreds of years this spot has been the locus of most, if not all, the epidemics of yellow fever which have claimed so many victims on the island itself and on the American continents. Our Government has wisely recognized the the placing and maintaining of the city of Havana in first-class sanitary condition must be the first step towards the regeneration of Cuba Libre. How best to accomplish the result with the least expenditure of money and time is, therefore, a question of international importance. The problem at Havana, we believe, consists not only in taking care of the accumulated filth within houses and on the streets, but in purifying that vast cesspool, Havana Harbor.

While it is not our purpose to formulate any definite plans by which this great work of cleansing Havana and its harbor can be accomplished, it seems to us that it is not out of place to suggest, at least, a method of electrical sanitation which has been tried successfully in this country. We refer to the Wolff system of sanitation involving the liberal use of electrolyzed sea water. With a number of Wolff disinfecting stations in operation at various points along the water front of Havana Harbor, and supplying also disinfecting fluid for the streets and private vaults in the city, it seems to us that it ought not to take a long time to place Havana in as pure and sweet a condition as has been the water at Brewsters, N. Y., where a Wolff plant has been in operation for several years past. Our readers will recall, also, the work accomplished by the system in the disinfection at Riker's Island, opposite New York. The conditions at Havana cannot possibly be worse than those which existed on that island, which had for many months been a dumping ground for New York's refuse. It might be judged by some that the volume of disinfectant required to purify Havana Harbor would be so great as to make the execution of such a plan hopeless; but when we consider that one part of electrolyzed sea water is sufficient to purify one thousand parts of the worst germ-laden fluid, it will be seen that the problem is by no means as formidable as it appears at first sight. Of course, the disinfection of a harbor such as that at Havana would not be accomplished in a few weeks, but that a marked improvement would be noticeable within a few months, and that possibly within a year the desired result would be completely accomplished, seems to us a possibility of such far-reaching importance that the experiment is well worth trying. The United States Government has undertaken a task from which it has pledged itself not to shrink, however great the burden may be, and we feel certain that Havana will, before long, be put in as sanitary a condition as any city, similarly situated, can be.

Mayor Jones.

NEW YORK CITY has lately had a visitor in the person of Mayor Jones, of Toledo, O., who filled quite a space in the newspapers with his talk in favor of the municipality owning everything and doing everything, because officials are able to run matters so much more efficiently and economically. This may be true of Toledo, but only when Mayor Jones is himself at home, with one eye on all departments and the other eye on his chances of re-election. The Toledo "Bee," just to hand, is raging about the condition of the streets, which, it says, are "dirty, very, very dirty; simply filthy." Yet the city owns waterworks and a fire department, but never a finger is raised by either to clean those wretched streets. Mayor Jones had better go home, and try to look after the things he is already mismanaging. The loudest talk about these municipal schemes seems to come from people least competent to conduct them with economy and efficiency.

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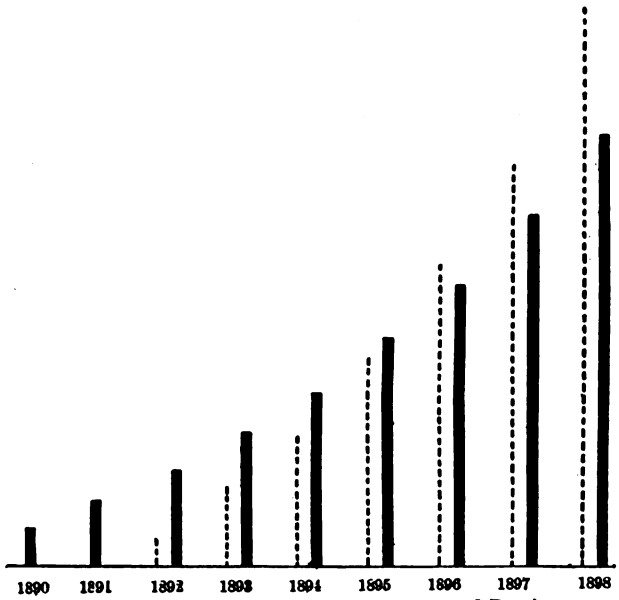
ELECTRIC LIGHTING.

English Electric Lighting Statistics.

FOLLOWING its usual custom, the London "Electrician" in its first issue of the year gives a complete set of statistics of the electric light central stations of Great Britain. Lack of space prevents us giving these valuable statistics notice adequate to their importance, but the accompanying diagram will afford some idea of the present state of the art in the British Isles:



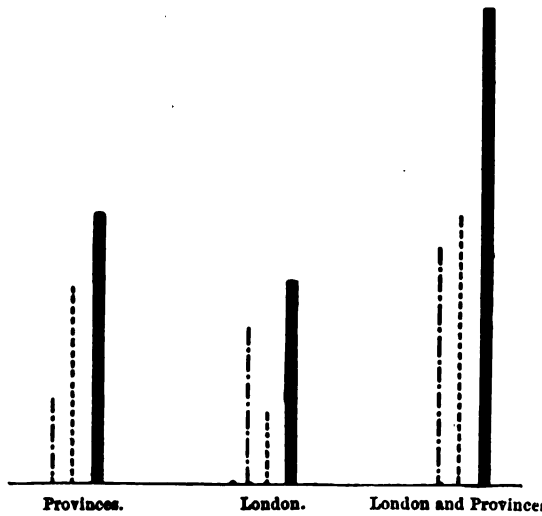
Lamp-Connections of London and Provinces.

London (————). Provinces (- - - - - - - - - -).

Scale: 1in. = 1,000,000 lamps.

FIG. 1.

The total number of lamp connections in the United Kingdom up to the end of 1898 is 5,206,000 8-c. p. lamps, or their equivalent, an increase of about 1,250,000 over last year, of which, roughly, one-third has been acquired in the metropolis and two-thirds in the provinces. This figure may be compared with the increase of 900,000 during 1897. The diagram, Fig. 1, shows the steady rise in the total lamp connections in London and the provinces since 1880.



Lamp-Connections to Continuous and Alternating Current Stations.

Alternate-Current (— — — — —). Continuous-Current (————).

Alternate and Continuous (—·—·—·—).

Scale: 1in. = 1,000,000 lamps.

FIG. 2.

In Fig. 2, which shows the relative number of connections to continuous and alternating current stations, the chain-dotted line has increased in length, partly at the expense of the dotted line, owing to a number of alternating stations having put down continuous-current machines for power supply. Thus the City of London Co. is added to the "mixed" stations this year, and in the provinces, Halifax and Salford among others, supply both continuous and alternating currents at present.

Systems of Meter Rates.[1]

BY EDWIN L. DEBELL.

THE study I have been able to give this subject has greatly increased its importance in my estimation, and impels me to urgently advise all central station operators to give it more serious consideration than it has yet received. We all know that our properties are operated at a poorer rate of economy than any other class of power plants, being in effective operation only a few short hours out of each twenty-four. Have we given due consideration to the cause of this defect; what means, if any may be employed to remedy it, and what a surprising amount of benefit would result thereby to ourselves and our customers? I think not, and the object of this paper will be an attempt to show how these conditions are affected by the systems of rates employed.

The contract, or flat rate system, although still in quite extensive use, is neither logical nor satisfactory. In the early days of electric lighting the service was employed mainly in business places, and only the number of lights needed for regular daily use were installed; lamps were all of one size, and the station usually run only until twelve or one o'clock at night. Under these conditions, flat rates were fairly successful, and could not be greatly abused. The fixed charges on the property, however, were very high for each hour of operation, and high rates had to be charged.

Nowadays the use of the service is more varied. Business places require a large number of lights for display and other occasional use, and we are called on to supply current to dwelling houses, shops, churches, halls and other intermittent consumers. Lamps are supplied in sizes from 2 to 50 c. p., and most of our stations are now operated all night, if not the entire twenty-four hours daily. Under these changed conditions, the flat rate privileges can be, and are, grossly abused. The central station is not only compelled to supply a large quantity of current for which no pay is received, but also to invest additional money in machinery to supply it.

The justice of charging each customer for the exact quantity of current used, and the employment of suitable devices for ascertaining that quantity, cannot be questioned. The number of recording meters installed within the past few years, and the constantly increasing use of them, indicates clearly that this is generally accepted as the true basis on which to frame the charge for electric current.

This proposition being accepted as true, we now come to the main question involved in this paper. What system of rates will be most just and satisfactory to our customers, and at the same time maintain or improve our present earnings?

First, let us study prevailing methods and see if they are founded on the true cost of production. The usual custom is to charge a fixed rate per unit, with discounts proportionate to the quantity used. The rate per unit has been determined either by the present average cost of the total units produced, by estimation, or by the rates in most general use by others. In any case, the cost has been made to include all fixed expenses on the property, such as interest, taxes, insurance, management, clerical work, etc., and which generally amount to 75 per cent., or more, of the total cost of each unit produced. As the great bulk of the station's output is accomplished in the three or four hours of heavy load each day, a like proportion of the fixed expenses are charged against that period. Thus, according to our own calculations, each of the remaining twenty or twenty-one hours has to stand but a small fraction of the fixed expenses, yet we charge our customers the same amount for each unit used in those hours as in the heavy load period. The process is one of average, and does not distribute the expense ratably to each customer.

It may perhaps be claimed that the process is fair on account

[1]Read before the Northwestern Elec. Assoc.

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of the manner in which we have to operate our stations, but it is a matter of great doubt whether this manner of operation is responsible for the present system of rates, or if the rates are responsible for the poor operation.

When we charge nearly or all of our fixed expenses against the current used during a few hours, and then assess it again on each unit used in the remaining hours, it makes the cost of the service especially burdensome, if not prohibitive, to those using it for long hours at a time. These customers are the most valuable to the central station, and should be encouraged by every possible means. We should do everything we can to keep them, and to secure more of them, as they keep our investment employed a longer time each day and add to our receipts, without any increase whatever in our fixed expenses, and very little in running expenses.

Let us study how a system or differential rates would affect this question. In order to apply such rates we first have to determine the total cost of production per unit, including fixed and running expenses of every kind. Next determine how much of the cost is for fixed expense and how much for running expense. If exact records of these costs have not been kept, a close enough estimate can undoubtedly be made to answer the purpose. It will be found that the running expenses form but a surprisingly small portion of the whole. This is not a supposition or guess work, but has been proved by the records of many well conducted stations.

The report of an examining board to the authorities of Aberdeen, Scotland, in 1897, gives some very interesting arguments on this feature. They refer to the poor rate of economy of the electrical plant owned by that city, and compare it with their gas works. They show that the former has to install and hold ready for use generating machinery sufficient to meet the maximum requirements of all their customers at any given moment. That their plant had a capacity, if run twenty-four hours daily, the same as the gas works, sufficnent to supply three and three-fourths millions units per year; yet in the preceding year, only 214.000 units, or less than 5¾ per cent. of the capacity of the works had been supplied. A load diagram of the station was shown, almost identical with those common to our own stations. The opinion of the board was that this unfavorable condition would be improved by a varying or differential system of rates, based on the true cost of production and giving discounts according to the value of the customer to the station, in contradistinction to the total quantity consumed.

They submitted a statement showing a comparison between their best and worst customer for the preceding year. The best was a comparatively small consumer of current, employing less than two horse power of the station's capacity, less than $400 of its capital, and chargeable with but $27.50 of the annual capital charges. He employed the service for 2,000 hours during the year, however, producing a revenue of $288, or about $260 over capital charges.

The other employed 177 h. p. of the station's capacity, nearly $37,000 of its capital, and was chargeable with $2,582 of the annual capital charges. He used the service but 61 hours during the year, paying therefor $823, or less than one-third of his portion of capital charges.

These are undoubtedly extreme cases, one showing a very large load on the station for about twelve minutes, and the other a small load for six and two-thirds hours per day for 300 days in the year. The system of rates recommended by the board would compel the larger customer to pay a very much higher rate, or to abandon the service and make way for customers of the other class, who would be encouraged by the lower rates the system would give them.

Mr. Arthur Wright, electrical engineer to the corporation of Brighton, England, and originator of the Wright demand indicator, gives some figures covering the ratio of fixed and running expenses in the Brighton plant, in a pamphlet published in 1896.

To show what a small portion of the total cost of production lies in running expenses, and why it follows that the output of a station can be enormously increased with only a small addition to the total expenses, he has selected and given figures on two periods of three months each, one ending July 31 and the other Dec. 31, 1895. In the first period, the cost of coal and engine stores amounted, in round figures, to $2,500, and the station supplied 110,000 units. In the other period, coal and engine stores cost $6,000, and the station sold 366,000 units. The fixed expenses were alike in each period, and with the possible omission of some unimportant items, the running expenses were increased only $3,500 to increase the output of the station three and one-third times. The company's records show that of the total cost of operating the Brighton plant in 1895, less than one-sixth part was for actual running expenses. This is the ratio, with coal at $2.50 per ton, and Mr. Wright states that at the lower cost of coal in nearby towns, it would be less than one-ninth.

To come back to the application of the differential rates. After the fixed expense has been determined, a ratable portion should be charged against each customer. A number of devices have been introduced to determine this ratable portion, further reference to which will be made later on. A sufficient rate is to be charged to cover both fixed and running expenses, until the customer has paid his share of fixed charges, after which the rate may be reduced so as to cover only the running expense incurred in supplying him, with, of course, a reasonable profit added. The plan does not necessarily reduce rates, except to such customers as are found profitable at reduced rates. Those who use a large quantity of current at infrequent and irregular intervals, or whose demand is largely during the hours of the station's heavy load, would not be affected in that way, and by the use of some of the devices employed the most undesirable of such consumers would be subjected to a higher rate. The tariff may be arranged to suit varying local conditions, as in present methods.

The main object of the differential rate, and which, if accomplished, is obviously of the greatest importance to all central stations, is to induce longer hours of use for our product, and enable us to make special low rates to those who can find use for current during our slack hours. Our best customer is he who employs our capital the greatest number of hours per day, and our present rates are calculated to repulse, rather than encourage him. He now uses as little current as possible, and that usually at the time when it is most valuable to the station. The remainder of the time, when we would be making most profit, even at a lower rate of charge, he "pieces out" with other kinds of light or power.

How plain it is to us when we pass a store in the evening and see in use only a few of the electric lights installed, that our revenue from that store is but a fraction of what it used to be, while our expenses go on the same as before. We feel this still more acutely when we see our service dispensed with entirely, and who of us can say that such sights are uncommon? Observation will prove that those most inclined to give up the service are meter customers running long hours, the very ones the station can least afford to lose.

In considering the adoption of differential rates, local conditions should be studied. If little or no demand can be found for current during the station's slack hours, even at a very low rate, the success of the system would be doubtful. If, on the other hand, a large demand could be worked up, the system would be highly profitable to the station and prove satisfactory to the public. The hours of effective operation would be increased, without any increase at all in fixed expenses. So large a part of the total cost is incurred in getting ready to supply current, and so little in actually supplying it after the machinery is started, that if central stations could be operated continuously up to their capacity, they could produce current so cheaply as to render competition out of the question. Of course this is an ideal condition and will probably not be reached in the near future, if ever. It should be possible, however, to improve existing conditions to quite a large extent, and I think we should not cease our efforts until we have at least found work for our stations that will materially increase their output through prolonged hours of operation. It seems clear that only by this means can we increase our business or even hold what we now have. If we can accomplish this, even to a moderate extent, it will so decrease the cost of production per unit that each of our present customers could have more current at the same, or less, cost than now, and the remainder, even if sold at a very low rate, would bring sufficient revenue to largely increase the station's profits.

New business for our maximum load period will not accomplish this, as it entails an almost proportionate increase in fixed charges and does not extend the hours of effective operation. A system of rates giving the service, to customers who can use it outside of rush hours, at prices they can afford to pay, seems to be the most logical and feasible way. It may not appear an easy matter to find such customers, but if we first thoroughly in-

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form ourselves how extremely low we could really afford to make the rates for a fair quantity of this class of business, the difficulty would not appear so great.

As to devices intended to carry out the plan of differential rates, they are of several forms. The Wright demand indicator, as its name implies, records the greatest amount of current used by a customer at any one time, the theory of its use being that such maximum demand on the station should regulate the portion of fixed expenses to be borne by the customer. It is assumed that the customer will use his maximum demand a certain length of time each day, coincident with the maximum station load, and for that much of the total amount consumed he should pay a rate sufficient to cover fixed and running expenses. For the balance consumed, as shown by the usual recording meter, a lower rate is charged.

The double recording, or two-rate meter of the General Electric Company, appears to be their regular type with the addition of an extra set of dials and a clock mechanism. The clock is wound half-hourly by the action of the current, and may be set so as to cause the meter to register on one set of dials all the current consumed during any predetermined period, and on the other dials at all other hours. The theory of the use of this meter is that a customer's portion of the fixed expense should depend on the total amount of current he uses during the station's heavy load and a lower rate be charged him for all consumed at other times.

It is claimed that it enables the customer to use current liberally during all the hours of the station's light load. Although costing about $25 more than the simple recording meter, it possesses the good quality of performing the entire work without the aid of any other device. The customer can readily see how much each of high or low rate current he has used and it is adapted to use on both direct and alternating systems. It has a mild tendency to prevent a heavy load during the station's rush hours, but not in the remaining hours when heavy consumption is rather desirable than objectionable.

The Oxley multiple rate meter controller, described in The Electrical Engineer of Jan. 18, 1898, is a small electro-magnetic switch, to be installed at each point of consumption, and to be operated by a controlling switch in the central station. It may be used in connection with two recording meters, closing the circuit in one or the other at the will of the station operator by his manipulation of the station controller, or it may be used with a single recording meter, in which case it employs resistance to retard the speed of the meter during the low-rate period. The theory of its use is the same as that of the General Electric Company's two-rate meter, although I am informed it cannot be applied to alternating systems.

No attempt is made herein to give a technical or lengthy description of these devices. More than a brief mention of them, as means with which to carry out the differential rate system, would be of no practical value in this place. If any of you wish to consider such a method of rates, you will want to study the various devices yourself, and decide upon their relative merits according to your local conditions.

The theory of differential rates may be applied in a modified form with the use alone of the ordinary recording meter. Mr. Thayer, of Belle Plaine, Iowa, describes a plan in The Electrical Engineer of Dec. 23, 1897, stating he had then been using it for about a year, and that it had been highly satisfactory in the cases to which it is adapted. He appears to have adopted it largely in order to avoid straight flat rates, and does not refer to it as a differential rate plan, yet it appears to be somewhat on the same lines.

To a customer who installs more lamps than are needed for regular every day use he makes a fixed charge of 33 cents a month for each light used during the hours of the station's maximum load, and 5 cents besides for each kilowatt hour consumed. The 33 cents may be considered a charge for fixed expenses, incurred in getting ready to supply him with current, and the 5 cents per kilowatt hour a charge for running expenses after the machinery has started supplying him. Mr. Thayer states that this plan has proved a good one for a large class of his customers. It prevents any wide variation in the monthly bills, which is a frequent source of complaint from customers during the winter months. At the same time, the certain revenue of 33 cents per light will, in most cases, cover fixed expenses, and the 5 cents per kilowatt hour a reasonable return for the service. It does not make the charge burdensome to the customer burning long hours, the very one we should seek to get. The monthly charge for a light burned daily two hours would be 48 cents; four hours, 63 cents; eight hours, 93 cents, and twelve hours, $1.23. Thus, a customer using lights until 9 o'clock p. m. daily throughout the year, would burn about two hours per day in the middle of the summer, making the cost per light 48 cents, and about five hours per day in the middle of the winter, costing about 70 cents, or an average the year round of a trifle less than 60 cents per month for each light.

A device such as the Wright demand indicator should be useful to stations selling current on the flat rate plan. Monthly rates could be made for each individual or class of customers, based on the greatest number of lights they would use at any one time, an additional charge to be made if that number should be exceeded.

In the case of dwelling houses, notice could be given the station when a large number of lights were to be used on special occasions, and the indicator could afterwards be reset. This would give the station knowledge of the frequency and extent that lights were used in excess of the agreed manner. It would check waste of current to a large extent, and reduce the maximum loads, especially in dwelling houses, where it is most serious, under the flat rate plan. The maximum station load would also be reduced, increasing its capacity and earning power, by making room for more customers with the same amount of machinery and coal consumption.

Any of the foregoing methods embody the differential rate theory in a greater or less degree, and should result in improved efficiency in the operation of our stations. If the system cannot be adopted in its entirety, some features of it might be applied that would meet local conditions more nearly than present methods, and work alike to the satisfaction of customers and the benefit of the central station.

To my mind, the question merits the careful study of every central station operator, and is of so much importance that if we fail to give that study voluntarily, the trend of our business will force it on us sooner or later.

MISCELLANEOUS

Electric Vehicles and Their Relations to Central Stations.[1]

BY PERCY MAXIM.

THE rapid advance being made by the electric motor wagon directs the attention of those interested in central station matters to the possible effect of this new industry upon central station affairs. An investigation has been made into the question, and it is thought that the results stated as briefly as possible may be of some interest at this time.

In the first place, however, attention is called to the present status of the electric carriage question in general, and to that phase of it in particular which seems destined to have the greatest practical effect upon central station loads, viz., public cab and omnibus service, electric delivery service for large retail concerns and numberless special applications where, for reasons of economy, flexibility, cleanliness, decreased storage space, electric traction must sooner or later displace the horse. Abroad, particularly in France, motor carriages have multiplied to such an extent as to require the careful consideration of the legislative authorities, and constitute an important factor in the life of the people. The French, however, in spite of their early and great success in developing the oil motor type of vehicle, appear to have overlooked the practical phase of the question as viewed from an American standpoint, and allowed their enthusiasm for the marvelous and exciting, their eagerness to outdo one another in long distance runs and trials of speed to be the controlling factor in their progress, in the course of which they have only just begun to turn their attention to the pecuniary advantages of the automobile. To the American manufacturer is due the credit of an early comprehension of the importance of the electric vehicle, and the fact that it offers the quickest and at present the easiest solution to the problem of

[1]Read before Northwestern Elec. Assn. Abstract.

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economically applying automobile traction to the practical purposes of every-day life, without, however, denying the broad and useful field which awaits the gasolene motor vehicle as its development proceeds. To be sure this conclusion corresponds more closely to American conditions than to those pertaining abroad, for, with the fine road system as it exists in France, a long-distance carriage has a great advantage over one with a limited mileage, while in this country the lesser mileage is sufficient to carry one within the limit of rideable roads encircling most of our American cities.

Acting along these lines our manufacturers have succeeded in placing the electric pleasure carriage on a firm, practical commercial basis, and the ready sale abroad in the very centres of automobilism of American electric carriages which has actually been effected is a gratifying testimonial to the correctness of the early views entertained as well as to the excellency of American methods in design and manufacture.

But that the immediate future points to a new era in the development of the electric motor carriage and a broader application of its utility to the commercial needs of life cannot for one moment be doubted by one who is familiar with the careful trials for some time conducted by extensive users of horse-drawn vehicles in our larger business centres, and as a result the capital actually appropriated by some of these enterprising but practical minded concerns for replacing a whole or a part of their horse equipment with electrically propelled vehicles. Like the trolley, the electric carriage has not only satisfied the expectations of its supporters, but has already opened up a field far in excess of their original hopes. A significant fact bearing upon this is the increased prominence awarded electricity abroad in the home of the oil motor carriage, and the attention which it is receiving from foreign manufacturers and capitalists. This development and introduction of electricity abroad, as contrasted with other motive powers, is certainly remarkable, and surpasses any prediction that could have been made a year ago. At a recent Paris cab contest, the most complete and practical series of tests yet given to any class of vehicles, 11 out of 12 competitors used electricity; so generally recognized is it that this is, for the present at least, pre-eminently the power for the congested traffic of large cities. As a result of this cab contest the entire Paris cab system will substitute electricity as a motive power before the close of the present year.

The following line of thought has been opened up, and the following data offered to call the attention of central station managers to the status of this new industry and better enable them to encourage this new use of electrical power, especially as it may in many localities offer a solution to the problem of approximating a continuous day load.

The battery is, of course, the prime consideration in an electric automobile. The type of battery giving the greatest capacity per pound, apart from other considerations, is probably found in some form of pasted cell and the future battery for motor carriage work is quite likely to be a high capacity, durable cell of this type, but there are objections to all existing forms of pasted cells on the score of delicacy and short life, and the Pope Manufacturing Co. and the foremost American makers, after testing the principal types both here and abroad, have almost universally adopted a combination type of cell as most nearly fulfilling the requirements.

The present state of the art requires that a cell in order to be of any value should show a capacity of from 3.5 to 4 ampere hours per pound of cell complete with lugs, jar, etc., at a discharge rate of not less than 1.3 amperes per pound of complete cell. It must furthermore be possible during discharge to increase this rate to 4 or 5 amperes per pound of cell for short periods, without injury, and to charge it from empty to full in three hours or thereabouts. With a battery coming up to these specifications a mileage of thirty-five can be obtained under favorable conditions with an electric phaeton seating two people before the point of injurious exhaustion has been approached. This performance can be and has been greatly surpassed by the use of high capacity cells of short life, and a run of 92 miles is actually reported from Paris, but this practice is generally condemned by American engineers as removing the electric carriage too far from the field of practical utility by the use of a battery incapable of rough usage and economically useless through its short life. In France several firms are engaged in the business of letting out or caring for vehicles fitted with high capacity batteries, the great demand for which enables them to charge such rates as to realize adequate profits in spite of the frequent renewals of the short life cells. The conditions which admit of this practice are plainly of a temporary nature, and American builders have, we believe with good reason, refused to lose sight of the practical features of this question for any mere consideration of display or temporary profit.

The usual American practice is to equip a vehicle with 44 cells in rubber jars, four groups being formed by boxing together 11 cells. This makes a combination which can be charged from a 110-volt circuit, and three speeds can be obtained by merely changing the grouping of the boxes and the consequent voltage applied at the motor terminals. Thus, with all four groups in multiple, at a reasonable discharge rate approximately 22 volts are obtained, two in multiple and two in series 44 volts and double the speed; all in series, the full voltage of the battery is reached.

Series motors are in general use, employment sometimes being made on the same carriage of two motors mechanically separate, but series connected, each geared to its own driving wheel. In this way an electrical balance is obtained between the driving wheels, and the alternative of a mechanical balance is obviated. Experience has shown this, however, to be an advantage only in special cases.

Let us take for discussion a single-seated Columbia phaeton, as this represents a common type, is built by a well-known firm, and may be regarded as the standard of the day in its own field.

This carriage complete weighs approximately 2,000 pounds, 45 per cent. of which is due to the battery. The controlling apparatus consists of a foot lever connected to a band brake, a steering lever at the driver's right hand, the controlling lever at his left, a push button for an electric signal bell in the controller handle and a foot reversing lever used only preliminary to backing. This carriage is at all times under the perfect control of the driver, can be turned in a 26-foot circle, and can be stopped on the level when going at a rate of ten miles per hour within twenty-five feet from the point of application of the brake, if the occasion demands ignoring the wear upon the tires. It can be operated with ease by persons without previous experience.

The batteries can be charged inside the vehicle when the service demands it. To this end each carriage is provided with a flexible conducting cable to connect with the source of supply terminating in plugs of different diameters. These plugs fit into corresponding receptacles at the rear of the carriage, and in no way can a mistake be made in inserting them, owing to the difference in size. Better care can, of course, be given the batteries when removed and exposed to the view of the attendant, and this is ordinarily done when possible. The battery is placed upon the 110-volt circuit with the interposition of a sufficient resistance to bring the current down to 40 amperes for this particular type, at which point it is maintained until the voltage has risen to 110, when the current is allowed to diminsh until it has reached but a few amperes. This method completes the charge from empty to full in three hours. Automatic features for cutting out the battery when full have been introduced with success by combining a recording wattmeter with a cut-out magnet. This wattmeter registers the watt hours of discharge by a movement of the pointer in one direction, while the charge is recorded by an opposite movement of the pointer, each scale division on the return movement, however, corresponding to a sufficiently increased number of watt hours to adequately provide for the average internal loss in the batteries so that when the zero or full position of the scale is reached on charge, the batteries are again in a fully charged condition, and a contact is made which operates the cut-out. As popular knowledge respecting storage batteries increases, however, it is probable that devices of this nature will be eliminated for the sake of simplification and used only occasionally; for it is found that a little familiarity with the subject enables one to form a most accurate estimate from mere observation as to when the fully charged condition has been reached by a battery. As regards discharge, one's senses soon become so trained that a very accurate determination of the voltage, and hence the condition of the batteries can be made by noting the diminishing speed of the carriage, slight as it is.

It has been found by experience that the average coachman or caretaker, after a week's instruction, is competent to care for an electric carriage. With the exception of the batteries the attention required is no more than that necessary for an ordinary horse vehicle, and no more complicated than that given a bicycle, and the mere routine of charging the batteries and maintaining the electrolyte at the proper specific gravity is soon learned.

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When we come to the application of electricity to the delivery business it might seem at first as if a vehicle reaching its limit of continuous mileage in the thirties were laboring at a disadvantage. This is not the case. An investigation of the daily mileage of the busiest delivery wagons of some of the largest houses shows that rarely does a wagon accomplish 18 miles on a single trip, and that a considerable interval invariably elapses between trips. Thus not only is the mileage sufficient, but delivery wagons built for light goods delivery are at present designed for a maximum mileage of 25, thereby gaining decreased battery weight. The interval elapsing between trips is utilized to charge the batteries in the wagon, which requires approximately two hours, for they are but partially exhausted.

An excellent example of the advantages of this class of service is shown by an electric mail van used by the post-office authorities in London. This van makes six trips per day between the main and branch offices, a total mileage of 40, with one set of batteries. On each trip it carries about 1,200 pounds of mail matter. Actual tests of the power consumption of the heavier class of electric vehicles show that 65 watt hours per 1,000 pounds per mile at a speed of 10.5 miles per hour is a conservative estimate, in fact, probably rather high, as these figures were obtained over suburban roads, and not on hard pavements. The expenditure necessary to recuperate the batteries may be liberally estimated at 100 watt hours per 1,000 pounds per mile.

The following delivery wagon actually built, a good example of the dry goods type, may be considered in this connection: Total weight, loaded, 4,500 pounds, including weight of two drivers and 1,000 pounds of useful load; maximum mileage, 25; weight of batteries, 1,300 pounds. From the above consideration the expense of running this wagon on a 15-mile trip would be the cost of 6.75 kilowatt hours, and 13.5 kilowatt hours for two trips. From figures obtained from prominent retailers in the large Eastern cities, it appears that the cost of stabling one delivery horse at the owner's stable, cost of shoeing and repairs for harness amount to $250 per year, and as an electric delivery wagon can be run continuously, save for short intervals of recuperations, and can, therefore, do the work of two horses, double this amount, or $500, per year is the expenditure for the operation of equivalent horse service. On a basis of two trips per day for the electric wagon, the yearly expense of operation, allowing 300 working days to the year, is that of 4,050 kilowatt hours. Any reasonable price for power leaves a considerable margin in favor of the electric carriage.

The custom of the large retailers is to dispatch fresh deliveries at frequent intervals. These are divided into several classes; some go to the extreme range of distance, others go but a few miles and, returning quickly, make a large number of trips during the day. Starting in the morning, then, with the batteries fresh, no charging current would be required until the first short trip had been finished, when each battery as it is connected to the charging mains would take 50 amperes. This current would soon diminish for a single battery, but as the separate sets would be connected in and cut out from this time on, a fairly constant load could be expected until mid-day, when there would probably be more or less of a peak. This would be followed by an afternoon load, and another peak at the close of the day. This, of course, is merely a general supposition as to the power consumption of one large concern. The use of electric wagons by a large number of smaller concerns operating under different programmes, a situation which the majority of central stations is more likely to meet, ought to effect a day load approximating a fair degree of constancy.

The operation of a cab or omnibus system would work to even greater advantage to the central station. An omnibus system planned for one of our central cities provided for 9 vehicles each carrying 12 persons and running under a headway of 5 minutes. The route to be traversed will necessitate the expenditure of about one-half the charge of the battery, so that each set can be brought to the full condition in two hours or less. This would, of course, necessitate a change of battery for each trip, and, when running on a 5-minute schedule, a total of 24 sets of batteries constantly on the line. At the end of every 5 minutes a set would be cut out and a new one put on in its place. This would cause a load of approximately 930 amperes diminishing to 880 at the end of 5 minutes, when it would again rise to the maximum.

The demand for omnibus service in many places, especially in certain localities where, for aesthetic reasons, the trolley lines are excluded, is without doubt a real one, and will, within the next twelve months, call for the equipment of many such lines. The success in many instances must rest in a measure upon the co-operation which the central station owners afford, and it would seem that the desirability of increasing the day consumption of power and the ultimate immensity of this demand would invite their most favorable attention. The consumption of day loads by electric vehicles offers such manifest advantages that the lowest possible rate should be made this class of customers for the encouragement of the industry, and from considerations of its coming importance. Prices for charging current for storage batteries vary over a considerable range, partly on account of the differing conditions of day load in different localities, but mainly owing to the novelty of the service which would necessarily tend to make the price uncertain, but as an indication of what can be accomplished, one of our largest cities considers the day load which is gained by this service to fully warrant it in offering current at two and one-half cents per kilowatt hour, of course in reasonable quantities.

An important aid in popularizing the electric motor vehicle would be rendered by central station owners, were they to provide their plants with the apparatus necessary to charge a carriage, and thereby invite public confidence in the existence of charging facilities at all stations, thus relieving the technically uninformed man of much anxiety and care when he is obliged to cover unknown territory with his vehicle. Quite an important and novel feature in this connection is the use which will shortly be made in New York, and will be capable of indefinite extension, of a so-called charging "hydrant." This is now being perfected by a prominent electric company, and consists of a coin-controlled mechanism with a wattmeter, voltmeter, rheostat, switch and terminals, such that the driver of an electric vehicle after having deposited the necessary coin in a slot can draw upon it for a certain number of watt hours. The general adoption of some such device as this, and the certainty of finding it in different localities of a city, would greatly encourage the general use of electric automobiles.

The smaller plants within twenty-five or thirty miles of each other will feel the influence of the pleasure carriage, and regularly established touring routes will soon be a fact through those localities where the lighting stations have had foresight to provide themselves with facilities for charging. Many central station managers have needed no light to point them the way. The station of the Central Railway and Electric Co. at New Britain, Conn., provided itself with facilities for charging itinerant electric vehicles nearly two years ago. In alternating plants if possible means should be provided for obtaining direct current from some other source than the exciters—either a direct current machine or a rotary transformer. A small recording watt meter would be found a valuable adjunct, while a voltmeter, small rheostat, switch and charging leads would comprise the list of essentials.

After all, we are mainly interested in the appearance of the ledger. The greatest financial problem which has confronted the managers of central stations has been the relation between the cost of installation and the return thereon, which must be secured during a very small portion of the hours of the day. It does not seem to me to be an exaggeration to say that the horseless carriage builder now offers the solution to this vexed problem.

Power Brakes for Street Cars.

The New York State Railroad Commission is making an effort to secure power brakes for surface electric street cars. This class of cars is at present equipped with the ordinary hand brakes, such as were used on the old horse cars. With the increased rates of speed and the weight of the street cars now in operation the Commission considers the brakes in use insufficient. The reason why the street cars have not been fitted with power brakes is because no brake of that character has yet been found to meet the requirements. Several inventions have been tried, but they have not proven satisfactory. The railroad companies have been compelled to continue with the service of an improved hand brake. In order to secure, if possible, some invention which will approach the standard required the State Railroad Commission has sent out invitations to all persons interested in power brakes to participate at a test of brakes of this character. The tests will be made in New York City on one of the lines of the Metropolitan Street Railway Company, under the direction of C. W. Barnes, electrical expert of the State

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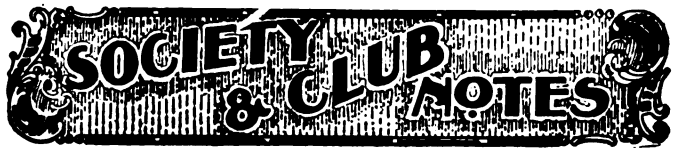
Commission. The date for the experiment has not been set, but it will be within the next two months.



Seventh Annual Convention of the Northwestern Electrical Association, Milwaukee, Wisconsin.

WEDNESDAY MORNING SESSION, JANUARY 18, 1899.

THE convention was called to order by President Copeland in the clubroom, Hotel Pfister.

SECRETARY MERCEIN, in a brief address, stated that the Northwestern Electrical Association had now the largest membership of any electrical association in this country, and for six years' growth that was a pretty satisfactory condition of affairs. (Applause.)

THE QUESTION BOX was then taken up and questions presented as follows:

Q. 1—What is the best way to enlarge the arc, incandescent and motor capacity of a plant that is now "filled up" in all departments?

Q. 2—For a plant in a small city, no day circuit, services to midnight only, what method of charging for lights would give best satisfaction to company and consumer?

Q. 3—Which of the following methods would give best satisfaction in supplying lamps: (a) Plant to furnish lamps free and change them when burned dim? (b) Plant to charge for first lamp, renewals free, customer pays breakage? (c) Plant to sell lamps at cost, no free renewals? (d) Customer to buy lamps in open market, plant having no say as to make?

A number of applications for membership were presented and acted upon.

MR. DOHERTY: I might say a few words in regard to the first question, "What is the best way to enlarge the arc, incandescent and motor capacity of a plant that is now filled up in all departments?" It looks as if the only answer to that question was to build a new plant. But a great many interesting points might be brought out in that question, for instance, if the station was filled up in every department, yet the managers might not have the money, or feel that it was advisable to put in a complete new plant, new arc machines, new alternators, and might want to make an increase in one line this year and in another line the next. There are a dozen different ways of doing that—putting arc lamps on the transformers around the station, cutting them in and out with knifeblade switches, etc. I do not think that there is an automatic switch now on the market for alternating currents, but one is expected soon. There is a switch for the direct current working by clockwork, throwing lights on and off, on circuits like the Edison, and where they do not use series lamps. I would not undertake to answer that question, for one moment, but I suggest that an alternator with reserve capacity for future needs to be put in that would enable them to lighten up the load on the arc machine and take on more lamps. Then they could transfer service back and forth, between one department and another, and in that way save considerable on the enlargement of the plant.

MR. SCHOTT: There is only one way to answer this first question, outside of the arc end of it. On the incandescent and power end of it, the true way to take care of that is, to put it on the meter basis. On the arc end, if the station be equipped with straight series arc apparatus, while it can be metered, it is not exactly what you might term practical. I know of one town that within the last two or three years was placed in this position: They had overhead circuits and they were forced within a given district to go underground. In that underground district they had in the neighborhood of about 25 miles of arc circuit, while the question of ducts, cables, etc., necessary to place series arc commercial work underground, meant quite a large sum of money. On the other hand, in changing from the series arc at a flat rate, over to the incandescent circuits and on a meter basis, it meant quite a loss in the income, but after considering this matter very thoroughly, they finally concluded to adopt the enclosed style of lamp on a meter basis. The result was that the increase in cables, etc., was very slight over what they had been obliged to use before, in operating their incandescent end of it, and the first year the loss in income was $21,000, but the third year has proven that the average rate received for arc lamps connected, is higher than when it was on a flat rate basis. They avoided the increasing of the capacity of the station, and the additional investment in conduits and cables. As a rule, when customers change from the series arc to the enclosed arc, they are not as well satisfied as they were before, for the reason that the series arc light will throw more light on the ceiling, but after the service has once been put in effect, the customer grows used to it and knows that he can turn the arc on any hour of the day or night, and sees the advantage of it. In two years you can convert any man, no matter how far he has been on the other side of the fence. I think the only way to take care of the business and provide for additional capacity without increasing your station, is as stated.

MR. LIVERMORE: In regard to the incandescent end of the business, this question depends largely on the efficiency of the incandescent lamp. If a plant is wired up altogether for 4 watt lamps and 3 6-10 watts, if the regulation of that plant is good enough, they can use a 3 watt lamp and increase their capacity very largely in that way on the incandescent lamp and on the alternating business. Where they are using the new three-wire transformers which are made now of very high efficiency, a very material saving can be made in the dead load carried by every alternator, and in every plant using the old type of transformers made previous to four or five years ago. I know in my case I have made a plan which I am going to carry into effect at once, by which I replace 49 old type two-wire transformers, with 11 three-wire secondaries. This change alone in the dead load carried by my alternating machine will make a difference of 8 amperes and 1,100 volts, and in that way you can make a very material saving.

MR. DEBELL: The question under discussion was suggested by myself, and I will state that the largest part of the business of our plant is done on a meter basis, and that as high efficiency of lamp is used as we think the station will stand in an alternating system. We have concluded that the only way to increase our capacity in the direction needed is by putting in additional machinery, and what we principally wish to know is, what knd of machinery would be best to put in, the simplest arrangement that would allow us to take on more business. The machinery in use now is an alternating system for incandescent lights, straight arc series—regular series arcs—for doing street and commercial lighting, and 500-volt power service.

MR. FRUND: In reference to this first question I would say, we had three years ago two 60-kilowatt alternators, very well loaded on nearly four-watt lamps, and the question arose as to the advisability of putting in more machinery. On a 100-volt secondary it was a pretty hard matter for us under test submitted to get anywhere a three-watt lamp, but we finally had a manufacturer that furnished us a 3½-watt lamp; and in that way we avoided putting in new machinery for the time being, but in a very short time that extra installation was taken up. We were then running on a flat rate very satisfactory to us, but it meant another expenditure of something like $8,000 on the incandescent plant for new business. The question resolved itself into this, whether or not it would pay us to put in meters or go on with a flat rate, and run the risk of reducing our income on a meter rate. Having seen some of the results in other plants where the meter rate reduced the income considerably we were in doubt, but we finally resolved to put in meters, and the consequence of this was that a 60-kilowatt machine did the work where we required two 60-kilowatts before. It took us nearly two years to get on our feet, but now we have a very satisfactory service. We have no trouble at all now on meters, or with meter rates.

MR. THAYER: I think really that the most valuable thing for us to know would be what the other plants have actually done, rather than what we would do if the case were presented. Take the case at Cedar Rapids, near where I live. There is there a typical plant of the old style—that is, with alternating current, small transformers, 500-volt power circuit and series arcs. They have reached the limit of their station, and last year they began putting in two-phase alternators and throwing out a good many of their old transformers, and they are gradually changing their power business, wherever practicable, into two-phase motors, with the intention of ultimately throwing out all of the 500-volt system and running their alternators for the day load.

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The series arcs on street circuits they would keep, but they are installing a good many more. All their extra arcs are going on the alternators. They are using a few big alternators rather than a number of the small types of the smaller machines. That is the way one large plant solves the question.

MR. GROVER suggested that a committee be appointed to establish uniform rates for power service. Regarding flat versus meter rate in two plants which he had changed over from contract to meter, he found that the revenue went down the first year about 20 per cent., and operating expenses decreased about 33 per cent., and the second year the income increased 50 per cent., and the operating expenses still remained about 30 per cent.

MR. THAYER: On the question of changing over from contract to meter our plant, like most of the rest, was once entirely on a contract basis; but we started out first with the houses, putting them in at 18 cents a thousand watt hours, and, of course, that was entirely new business, and we had no trouble, but the hard point was to get the stores to put in meters wherever possible. Now, where a man has a certain number of lights, and he burns them regularly every night, and certain hours, we do not say much to him, but if a customer wants light which he expects to burn at unusual, or intermittent times, we either name him a high contract rate or a meter rate, such as would be to his advantage to go on. But we make the distinction also that a good many plants do not, in giving him a discount for long hour service, and not on the amount of light used. It may be that he is a customer who closes early, and uses an immense number of lights, up to our capacity, and then he shuts his lights off. Our first efforts were to charge him a rate of 33 cents a month per lamp, and 5 cents a thousand watts, by meter. That was made to fit into the rate that the customer had been receiving. We have followed practically the rates of the Chicago Edison Company, charging 20 cents a thousand watt hours on a $3^1/_{10}$ watt lamp basis for the customer's average the year round, and half a cent for all succeeding hours. That rate gives us an equivalent rate of about 13½ cents a thousand watt hours in a store, as the lights are usually burned, and it has the additional advantage that if a man wants to take extra long hours, instead of paying in the neighborhood of 14 or 15 cents, he is only charged 10 cents for that extra burning. For the first hour during the six lighter months, and the first hour and a half during the six winter months we make a modification, and that is to forestall the time when we will put in meters, and if a man loads up his store for the holiday season, he has got to pay for it, but at present it has the advantage of equalizing bills, cutting down the heavy winter bills and making the summer bills a little larger. I think you will find in changing over to a meter basis, you have trouble with heavy winter bills, and if you get a system of discount that you can cut down your heavy winter bills, you may get more from your customer by the year than you can by letting his bills run way down in summer time and way up in winter time. We go on the basis that a short-hour customer has got to pay a large price, and a long-hour customer will get a very substantial reduction on the rates, and so far we are gradually working over on to a meter basis. We have got, I think, 40 or 42 per cent. now on meters, and that has all been done within three years. So far we have kept right at it, and whenever we can nail a customer to get him on meter, we do it, and in time we will have pretty nearly everybody on meters.

An adjournment was then taken to 2 o'clock p. m.

WEDNESDAY AFTERNOON SESSION.

The convention was called to order by the President, who read his address.

PRESIDENT COPELAND'S ADDRESS.

Six years ago a few Wisconsin electrical men met together and organized the "Northwestern Electrical Association," calling their meeting its First Annual Convention and themselves its charter members. To-day, at its Seventh Annual Convention, the "Northwestern" is the largest electrical association in the country, and its members gather together from Ohio on the east to Colorado on the west, and from Arkansas on the south to Manitoba on the north.

President Copeland then gave what he believed to be the reasons for this striking success of the association, namely, its broad character, virility, low cost of membership, etc. He referred to the suggestion which had been made that the association have but one meeting a year. Also to the question whether they should not adopt some systematic plan of compiling and issuing to members published articles of interest to members, such as articles on municipal ownership, be they in favor of corporations or municipalities; reports of cities operating their own plants or any other matter that would be of benefit to members of this association. He would suggest that a committee consisting of the secretary and two members be appointed to collect data, etc., that in their judgment would be of value to the members, have it compiled in suitable shape for filing, and copies sent to each member.

Another suggestion was that the association have a representative at each State capital in its territory. The President also advocated the payment of a salary to the Secretary, and an increase of the dues to $10 per year.

"New Business" was then taken up, and the following resolution was offered by MR. SCHUETTE:

"Resolved, That Article II. of our by-laws be amended by adding a new section, as follows:

"Section 3. Whenever the officers of this Association may deem it necessary to raise funds, for the purpose of protecting the material interest of our central station owners.—In that case they are hereby authorized and directed to levy an assessment on all central station members in Wisconsin, in an amount not to exceed 10 cents for each k. w. dynamo capacity of their plants, in any one year."

The resolution was referred to a committee for report, as some of the members objected to having a representative for Wisconsin legislation only.

MR. B. J. ARNOLD then read a paper entitled "The Trend of Central Station Design."

In reply to a question Mr. Arnold said that in regard to the use of jet or a surface condenser, it depended upon the location of the cooling tower. It is usually necessary when a cooling tower is used to place it upon the roof of the building, and then by all means a surface condenser should be used, because one has a closed column of water to deal with. With a surface condenser one avoids the danger of the flooding of the engine, which would happen if one had a great body of water on the roof and the jet condenser should fail. That would wreck the engine, as actually occurred in a very large station recently. Regarding the cooling effect that depended on the size of the tower and of the fan, which means consumption of energy. Ordinarily, this water leaves the condenser at 190 or 200 degrees, and one can reduce it down in summer time to from about 92 to 96 degrees, and in the winter to 65 or 70. It was not advisable to attempt to get too great a reduction of temperature, because it takes too much water.

THE PRESIDENT: Would it be proper to use water at a temperature of 80 or 90 degrees on a jet condenser? I should think it would require too much water to get your vacuum.

MR. ARNOLD: We are doing right along, as, for instance, at the Englewood plant. We use the same water over and over again, and we add probably 5 per cent. to that water to make up for loss by evaporation. Where you can place your cooling tower on the ground it is advisable to do so, and to use the jet condenser, because it is much cheaper to do so than to adopt any other plan.

MR. STEIN: I understand Mr. Arnold to say that the net efficiency of a combined synshronous motor and arc machine outfit was something like 72 per cent., where the efficiency of the rotary converter was 90 per cent. or more. Do I understand you to mean by that that there was any inherent disparity in efficiency between the synchronous motor per se and the rotary converter?

MR. ARNOLD: No, I did not mean that.

MR. STEIN: Was not the apparent disparity due to the fact that the arc machine was necessarily less efficient than either of the other machines, and that the arc machine was perhaps a 75-kilowatt machine, and, therefore, naturally of lower efficiency than a large-sized rotary converter would be?

MR. ARNOLD: That is partially the explanation. The reasons for the discrepancy in the efficiency of the two machines are three, viz., the low capacity of the arc machine and its consequent less efficiency than the other machine and the efficiency of the synchronous motor. When we have a combined unit of that kind, a synchronous motor driving a series arc machine, we have two small machines. Into the motor we feed the alternating current. That is simply a motor, and it has a certain efficiency, probably not over 92 per cent. It then drives mechanically an arc machine which has an efficiency of

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only about 80 per cent., possibly less. So that the combined efficiency of the two machines is much less than that of a rotary converter, the latter consisting of one machine, of a single armature, of a single field, the armature having a direct current commutator on one side and three-phase collector rings on the other, the current going into the armature and coming out at the other end. That is the reason that it is so much more efficient.

MR. STEIN: But the synchronous motor taken by itself would be just as efficient as a rotary motor of the same size, would it not?

MR. ARNOLD: Yes, sir.

MR. STEIN: There is one other matter that I would like to mention. The statement was made regarding the alternating arc lamp, to the effect that as there was a deposit of ashes formed in the globe, it became necessary to clean the alternating lamp more frequently than the ordinary arc current lamp. Is it not a fact that the alternating current arc lamps burn so much longer than the direct current lamps, that, as a matter of fact, they actually require less cleaning?

MR. ARNOLD: I should probably have stated in my remarks that I was comparing the alternating arc lamp and the modern enclosed arc lamp. On that basis, I think my remarks would be correct. Regarding the series arc lamp, I think you are correct, because it requires attention oftener than the alternating lamp would.

MR. KORST: Can either end of the rotary converter be used as a motor and the other part as a generator, as made today?

MR. ARNOLD: You can feed the direct current into the direct current end and take the three-phase current out of the other end, and you can feed the three-phase current into the three-phase end and take the direct current out of the other end. It is completely interchangeable in that respect.

A vote of thanks was unanimously tendered by the association to Mr. Arnold for his able address.

MR. E. L. DEBELL, of Sheboygan, then read a paper on "Meter-rate Systems."[1]

In the discussion which followed MR. THAYER said it was not figured that 33 cents would cover the fixed charges. "I did not go so deep as that, but our store business is on a contract rate of 60 cents a month, and our all-night service is $1.20. The kind of stores I had in mind to fit this rate is where the evening charge on that system would amount to 60 cents a month, and if they ran on all night work it would amount to the same as the contract on all night work, in each case running a little bit over, so that the man would have some incentive to save in order to come down to the regular contract rate. The idea I have followed all through in changing from contract to meter rates, is to make the contract rates and the meter rates fit into each other. You cannot make a customer who has been burning lights in a certain way make an abrupt change from contract to meter, unless you give him a meter rate such as will cut down your revenue considerably, in which case the station is the loser and no thanks are received, and if a fair rate is charged your customer kicks. The object was to make the change as evenly as possible, so that in the course of time we can get all our business customers on meters. We have no trouble with residences. In regard to the Wright demand meter, there are a number of little disadvantages in using that system, but they are not serious, and the system ought not to be condemned for them. One branch that must receive special treatment is halls, lodges, theatres, churches and buildings that use a large number of lights, and whenever they do use them they use them long hours during the evening. From the fact that these loads do not usually come together, the station is not concerned with the maximum of each load, and in that case a special arrangement would have to be made. In any case, we never put Wright demand meters on buildings of that nature. We make them a flat meter rate, and let them go at that. I do not think that you can handle it all on the Wright demand meter, although you might handle it on the two dial General Electric meter, perhaps. In regard to the handling of residences on the Wright demand system, where we have got to watch when entertainments, etc., are given, and go up and start the meter, that in itself is an item of expense. It may be small, but in a large plant this trotting around to readjust the meter takes considerable time, and we must figure that as one of the costs of the system. Another thing is that a man using three or four lights ordinarily on a house may have visitors come on suddenly, or come in the evening. Now, he is not going to be stingy. He will light up his entire house, and his meter will run up far beyond the usual demand, and that feature of the case should be looked at.

MR. LIVERMORE: I have always been an advocate of the meter system, and when I assumed charge of the plant I am operating now we had no meters. Now we have between 65 and 70 per cent. of our customers on meters. Some months ago we arbitrarily shut off flat rates, and since that time I have got my best customers. I think as soon as central station managers get their station output metered so that they know exactly what they are turning out, and then figure out what each department is costing them, take your meter customers and add them all up, and see how much per kilowatt you are earning by the meter system, and then take the portion of current that you cannot account for, which is all flat rate current, and divide that into the amount received, the total cash, which does not vary in the flat rate, a good many men will, like myself, nearly fall dead when they see the figures. We have come to a point in our town where, if we cannot sell on the meter, we will not sell it at all.

MR. GROVER: The station which I at present have charge of I took charge of something less than three years ago, and every customer was then on contract. At that time they had a load of about 3,300 lights for incandescent work. The maximum load was about 110 amperes alternating. We have now 95 to 96 per cent. of our customers on meters—not more than 5 per cent. off; and in that three years' time our business has increased from 3,300 to 6,500 lights, and I find it much easier to get a customer now than it was to get him on contract. Another point. In increasing, doubling, the amount of lights which we connected, it was only necessary to buy about 400 light capacity in transformers. The transformers that we had on hand I changed around. Where there was a transformer I put four residences on that same transformer. I average a residence at six lights in actual use, and I have never had a fuse blown out. The amount of it is that we have doubled the capacity of our plant, and have almost doubled the revenue, and at the same time we are not using as much ampere output in the station at the present time as we did before we changed to the meter system.

MR. INNES, whose company's franchise gave the customer the option of a flat rate or meter, said he had recently found it necessary to make a minimum charge of $1 per month, as the inductive meter failed to register properly on very low current consumption.

The paper was also discussed by Messrs. Schott, Debell, Norcross and Frund.

PROF. A. J. ROGERS was then introduced, and read a paper on "Electricity Direct from Coal."

On motion of Mr. Norcross the Convention extended a vote of thanks to Prof. Rogers for his able paper.

Mr. Doherty moved several amendments to the By-Laws, after which the convention adjourned to Thursday.

SESSION OF THURSDAY, JAN. 19.

The meeting was called to order by the president. The committee of five appointed the day before reported the following nominations, all of which were subsequently adopted unanimously: President, Henry L. Doherty, of Madison, Wis.; first vice-president, John H. Harding, of Laporte, Ind.; second vice-president, S. B. Livermore, of Winona, Minn.; secretary, Thomas R. Mercein, of Milwaukee, Wis.; board of directors for 1899: Col. W. W. Bean, St. Joseph, Mich.; J. H. Culver, Decatur, Ill., and George Innes, Eagle Grove, Iowa. The secretary-treasurer's salary was raised from $150 to $300 per annum. It was decided to hold no summer meeting in 1899. Prof. D. C. Jackson then read a paper on "Inductive Loads on Alternating Current Transformers." This was followed by the reading of a paper by Mr. Geo. L. Thayer, of Belle Plaine, Iowa, on "Design of Secondary Circuits in Alternating Plants."

At the afternoon session a paper by Mr. Percy Maxim, of Hartford, Conn., on "Electric Vehicles and their Relation to Central Stations" was read by Mr. Lord. This paper and the discussion which followed are printed on another page. Mr. J. H. Harding, of Laporte, Ind., then read a paper on "Utilization of Exhaust Steam," which was ably discussed.

The newly-elected president's suggestions were then acted

[1] See page 116.

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upon, and Mr. Debell was appointed a committee to revise the proceedings of the association. Another committee was appointed to adopt a permanent badge, and Secretary Mercein was elected a delegate to represent the association at the May meeting of the N. E. L. A. The president and a number of members made remarks relative to the objects and needs of the association, emphasizing the fact that they want papers more practical and less technical and those benefiting the managers of small plants—as well as those of larger ones.

SESSION OF FRIDAY, JANUARY 20.

The convention was called to order at 10:30 a. m. President Doherty in the chair. The committee on badge and amendments to the by-laws consists of Messrs. D. C. Jackson, L. E. Kerns and L. W. Burch. The convention then adjourned sine die.

Convention and Exhibit Notes.

MR. A. HAMACEK, of Sturgeon Bay, Wis., exhibited his new alternating current arc lamp in Parlor 2.

THE YARYAN SYSTEM OF HEATING from exhaust steam was ably represented by A. J. Stahl, who occupied Room 21.

GENERAL MANAGER KING, of the Cloos Engineering Co., of Milwaukee, dropped into the hotel daily and made many new friends for his company.

MR. JULIAN ROE, representing the Crocker-Wheeler Electric Co., was in attendance and found many listeners to his praises of Crocker-Wheeler apparatus.

MR. E. L. DRAFFEN, of the Fort Wayne Electric Corporation, attended the convention and looked after the interests of his company in his usual genial manner.

MANAGER JANSSEN, of the Vitro-Chrome Chemical Co., of Milwaukee, was in constant attendance, and interested many in the subject of coloring incandescent lamps.

PERKINS EL. SWITCH MFG. CO., of Hartford, Conn., was largely represented by Mr. E. K. Patton, their Chicago manager, whose happy smile was to be seen everywhere and at all times.

MR. ROGER A. SIMONSON, representing the Library Bureau of Chicago, was quartered in Room 10, explaining to central station men the card system of installation, meter record and accounts.

MR. W. W. LOW, the popular president of the Electric Appliance Co., of Chicago, was on hand as usual, occupying suite 17. Mr. Low is a host in himself and a royal entertainer and was ably assisted by Mr. B. B. Downs.

THE CHICAGO ARC LAMP CO. were represented by Schoenman & Keller, general agents. They exhibited their new improved arc lamp in Parlor 3, the extreme simplicity of the mechanism commending the lamp to all onlookers.

MR. FRANCIS RAYMOND, general salesman of the Chas. E. Gregory Co., of Chicago, came up on the special train on Wednesday and joyfully represented his company day and night. Mr. A. Louis Kuehmstead was very much missed, but was detained in Chicago by press of business.

THE ILLINOIS ELEC. CO., of Chicago, occupied suite 21 and 22; Mr. D. Dewey Newman and Mr. H. E. Adams made many new friends, and dispensed good cheer with a ladle to all comers. Their rooms were a popular rendezvous for delegates. President Healy and T. K. Cushing arrived Thursday noon.

THE CENTRAL ELECTRIC CO., of Chicago, exhibited in Parlor 3 the Zeco lamp, with which they are meeting with much success. Mr. F. M. Pierce and Mr. C. W. Cobb were on hand to welcome old friends and new ones. The absence of President George A. McKinlock was noticeable, though Secretary Charles E. Brown arrived on Thursday and was cordially welcomed by his many friends and acquaintances.

"DEARBORN are with you again this year," greeted the eye of the visitor to suite 12, parlor floor. The absence of President W. H. Edgar was noticeable and commented on by many of his electrical friends, but nevertheless the Dearborn Drug and Chemical Works were ably represented by Mr. W. D. Jameson, general sales agent, and Mr. James M. Frye, their Wisconsin representative. They distributed bottles of perfumery and handsome blotters as souvenirs.

JULIUS ANDRAE & SONS' CO. made their headquarters in the Sprague Co.'s parlor (for whom they are Milwaukee agents), showing a few samples of various styles of telephones, for which they have established a high reputation in the West.

MR. A. B. CONOVER, JR., and Mr. Adams represented the Jno. Roebling's Sons Co., and distributed a very fine memorandum book as a souvenir of the occasion.

MR. A. LOUIS KUEHMSTEAD, of the Chas. E. Gregory Co., of Chicago, attended the convention during the last two days, and was welcomed by his many friends, who had missed him during the first day. Mr. Kuehmstead reports that their business was increasing every day.

MR. F. OVERBAUGH, manager of the Chicago General Fixture Co., one of the pioneer electrical supply men, came up to fraternize with his numerous friends in the trade, and was assisted by Mr. L. W. Kittman. Their fixtures are considered by all in the West to be unexcelled.

THE HART & HEGEMAN MFG. CO., of Hartford, Conn., had their popular Chicago representative, Mr. George S. Searing, on the ground to look after their interests. Mr. Searing has innumerable friends in the West and is steadily increasing the popularity of the Hart & Hegeman goods.

L. A. CHASE & CO., of Boston, were represented by their well known and popular general manager, Mr. S. B. Condit, Jr., who made his headquarters in the parlor of M. B. Austin & Co. Mr. Condit showed samples of all their latest specialties and distributed some interesting literature.

MR. GEORGE CUTTER, of Chicago, was at the convention looking after the interests of his company, meeting his many old acquaintances and forming some new ones among the electric lighting fraternity. Mr Cutter as one of the oldest "old-timers" in the business has been making friends these many years.

THE ELECTRIC STORAGE BATTERY CO., of Philadelphia, placed their interests in the hands of their Chicago manager, Mr. F. H. Clark, who was ably assisted by Mr. R. B. Daggett, their Chicago engineer. Storage battery propositions are now of such interest to all progressive central station managers that they were kept busy all the time.

THE COLUMBIA INCANDESCENT LAMP CO., of St. Louis, were represented by their acting secretary, Mr. George P. Rex, who extolled the many virtues possessed by the popular Columbia lamp to many interested delegates. He also distributed a large number of their new catalogues, which is certainly one of the handsomest booklets ever brought out to illustrate incandescent lamps. Every one interested should possess a copy, as it is a thing of beauty.

THE SPRAGUE ELECTRIC CO., of New York, were represented by E. B. Kittle and C. G. Burton, who showed a few samples of their most recent types of fan motors, power motors and interior conduit; space being limited, it was not possible to show electric elevators, but interesting drawings and photographs of some of the most recent installations were shown to any interested in this class of work. Their new catalogue, No. 58, appeared to elicit a great deal of attention and was in demand.

THE VICTOR TELEPHONE MFG. CO., of Chicago, were represented by Mr. William T. Blaine and Mr. A. J. Rousseau, who had a handsome parlor, in which they showed a 200 capacity metallic switchboard, which consisted of a tripolar gravity drop, individual ringing keys and accompanying devices, which afford easy and rapid operation. They also showed a full line of telephone apparatus, consisting of high grade wall and desk sets, equipped with their latest design of long distance solid back transmitters and bipolar receivers.

M. B. AUSTIN & CO., of Chicago, were represented by Mr. M. B. Austin, Mr. W. A. Brown and E. W. Chandler, who showed a line of samples of goods manufactured by the following firms whom they represent in the Northwest territory: Safety Insulated Wire and Cable Co., Holmes, Booth & Haydens, Safety Conduit Co. and L. A. Chase & Co. They had on exhibition samples of Safety wires and cables, loricated conduit, K. W. weatherproof wire, Chase junction and outlet boxes, Elden circuit breakers, and the New York push button flush switch, which they are manufacturing and marketing themselves.

THE WAGNER ELECTRIC MFG. CO., of St. Louis, were as usual ably represented by their popular manager of sales, Mr. E. H. Abadie, who was assisted by Mr. G. B. Foster and Mr. James O'Brien, who showed a one horse-power single-phase alternating current 60 cycle motor operating a 6 ampere 125 volt generator. Current from the generator was run through one of their own switchboards, equipped with a voltmeter and ammeter for the direct current and a wattmeter for the alternating current. They also showed samples of their well known G. type transformers, which taken altogether, made a very interesting and handsome display.

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THE GENERAL ELECTRIC CO. had a handsome parlor at the Pfister, with a competent staff. They displayed to a great many interested visitors the new Thomson two-rate meter and distributed a lot of choice electrical literature on their various productions.

THE CUTLER-HAMMER CO., Chicago, have just completed a most successful business year in the manufacture of rheostats. They have trebled their floor space during the year and are said to employ over two hundred men. The success of the company is due largely to the untiring industry of Treasurer Mr. J. G. Hickcox.

MARTIN J. INSULL, of Chicago, had a parlor, in which he exhibited samples of D. & W. fuses, Fort Wayne incandescent lamps and Pittsburg transformers. Mr. Insull also showed the Wright discount meter, the American rights of which he has recently secured. The exhibit was in charge of Mr. Insull, Mr. C. D. Heile and Mr. Thomas James.

MR. E. W. GILLMER, of the Warren Specialty and Mfg. Co., of Warren, Ohio, appeared on the scene about the middle of the convention, and showed a handsome sample of a fan motor which they are going to put on the market this season. This is an innovation on their part, incandescent lamps having hitherto been their only product. Mr. Gillmer expects to go much more largely into the electrical trade, and has other good things on the way.

THE WESTERN ELECTRIC CO., of Chicago and New York, were represented by Mr. William S. Hine and Mr. A. M. Little, who had an attractive little parlor, in which, while they showed no apparatus, they had an interesting display of bulletins illustrating Western Electric arc and direct current apparatus, arc lamps and supplies, as well as Stanley alternating current machines, transformers and switchboard devices, etc. It is needless to say that Mr. Hine's long experience in the business was extremely beneficial to the Western Electric Co. in purveying a generous hospitality to the many delegates who visited the parlor, and Mr. Little proved himself an able lieutenant. A neat little souvenir in the shape of a card case was given away and much appreciated.

THE USUAL BANQUET was held on Thursday night in the Pfister Hotel, and was attended by about 125 delegates and supply men. Mr. Thos. R. Mercein, secretary of the association, officiated, and proved himself to be a most efficient and able toastmaster. The guests of honor on this occasion were Mr. David S. Rose, Mayor of Milwaukee, and Mr. George W. Peck, ex-Governor of Wisconsin. Mr. Rose replied to the toast of the New Year, and proved to be an orator of great power and eloquence, while Mr. Peck amused all by his humorous speech when replying to the toast of "Electricity in Our System." Many other speeches followed, intermingled by songs. The occasion passed off in very happy fashion, and will be remembered as one of the most successful banquets yet given by the association.

Tennessee Street Railway Association.

A State organization of street railways has been perfected in Tennessee. Companies at Nashville, Knoxville, Memphis, Clarksville, Chattanooga and other places have joined. Mr. Percy Warner, of Nashville, interested in the Chattanooga properties, is one of the leading spirits.

American Institute of Electrical Engineers.

The 131st meeting of the Institute will be held at 12 West Thirty-third street, New York City, on Wednesday, Jan. 25, 1899, at 8 o'clock p. m. A paper will be presented by Lieut. Comdr. S. Dana Greene, N. Y. Naval Reserve, on "Electricity on Board Ship."

A MONSTER TELEPHONE PETITION is talked of for New York City to secure "redress for the present alleged abuses and extortions."

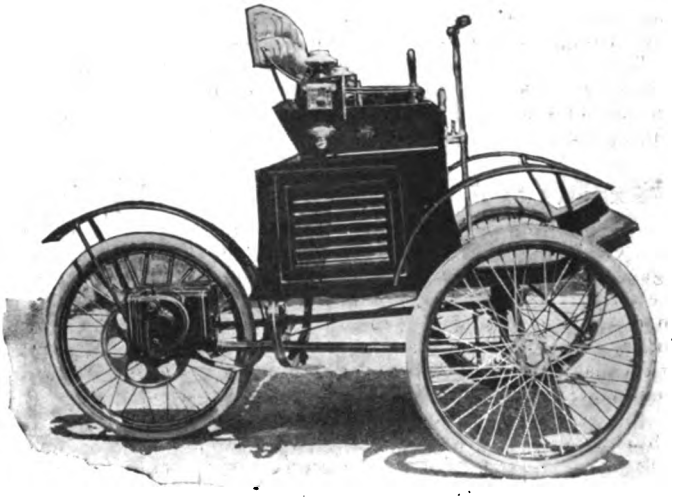
SANGAMON ELECTRIC CO. has been formed at Springfield, Ill., to manufacture electrical appliances, with a fully paid up capital stock of $10,000. The incorporators are T. F. Sheridan, T. B. McGregor and F. G. Houser.

AT BINGEN, PA., near Bethlehem, H. Wurster, a night operator of the Philadelphia & Reading Company, was murdered by robbers in the early morning. There had been a fierce struggle. An arrest has been made.

NEWS & NOTES

The New York Cycle and Automobile Show.

WHAT is called the National Cycle Exhibition opened in New York City at Madison Square Garden on Saturday, Jan. 21, to continue a week, and the fact that ten or twelve thousand people were in attendance the first night would indicate that the interest in bicycling still runs strongly. Moreover, a new element of great interest was interjected in the automobiles, of which nine were shown, of which some types are already familiar to the readers of The Electrical Engineer. A fine exhibit is made by the Riker Electric Co., and Mr. A. L. Riker was present with a competent staff to discuss the topic with swarms of inquirers. One of his novelties, the Riker electric tricycle, is illustrated herewith. It has a wheel base of 48 inches, has two wheels in front steering, a rear wheel carrying the motor, and weighs, without load, only 800 pounds. Its carrying capacity is 450 pounds, and it will comfortably accommodate two passengers. It has only one motor of three-quarters kilowatt capacity, and its controller permits of three speeds ahead and two speeds astern. A maximum speed of 12 miles an hour can be made, and a total run of 20 miles on level macadam with each charge. On the platform in front of the passengers is mounted a combination voltmeter and ammeter, and there are, of course,



RIKER ELECTRIC TRICYCLE.

POPE "COLUMBIA" ELECTRIC DELIVERY WAGON.

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electric side lights, a brake, etc. In addition to this, Mr. Riker showed his phaeton and one of his delivery wagons built for the Gorham Co.

The Pope Mfg. Co. have a fine exhibit in the centre of the hall, in charge of Mr. Joseph M. Hill, well-known in the electrical field. It comprises their Stanhope phaeton, double-seated carriage, trap, gasolene delivery tricycle and their new delivery wagon, mark XI., which is here illustrated. This delivery wagon is good for the heaviest work and weighs about 3,500 pounds. It is equipped with a motor of 4 h. p. nominal, and all make 25 miles on a charge, having a storage of 90 ampere hours and discharging at 25 amperes per hour.

The Waltham Mfg. Co. had on view in the space with the Orient wheels a very light trap or dog cart, said to be built on French lines, with storage batteries in the box under the seat and one motor, with housed gear, driving on the rear axle. At the time of inspection no one was present to give details, but the carriage looked well and attracted much attention.

The U. S. Battery Co., of 256 West Twenty-third street, New York City, had an excellent display of their neat and pretty electric bicycle and carriage lamps. The exhibit was densely thronged all the time.

Exports of Electrical Material from New York.

The following exports of electrical material are from the port of New York for the week ending Jan. 17: Antwerp, 22 packages, electrical material, $1,990; Argentine Republic, 15 cases electrical machinery, $174; Amsterdam, 10 packages electrical material, $550; Bremen, 13 cases electrical material, $8,395; Berlin, 27 cases electrical material, $630; Belfast, 15 packages electrical material, $324; British West Indies, 11 packages electrical material, $855; Brazil, 7 packages electrical material, $300; British possessions in Africa, 5 cases electrical material, $750; British Australia, 15 packages electrical material, $1,066; Canary Islands, 11 packages electrical material, $575; Central America, 145 packages electrical material, $2,269; Cuba, 76 packages electrical material, $1,265; Chili, 3 packages electrical material, $25; Ecuador, 1 case electrical material, $24; Glasgow, 149 packages electrical material, $10,220; Genoa, 5 cases electrical material, $176; Hamburg, 109 cases electrical machinery, $4,605; Hull, 9 cases electrical material, $327; Havre, 43 cases electrical material, $3,014—8 cases electrical machinery, $1,317; London, 161 packages electrical material, $25,728; Liverpool, 86 cases electrical material, $3,564—2 cases electrical material, $700; Mexico, 251 packages electrical material, $2,132; 12 packages electrical machinery, $1,356; Milan, 36 packages electrical material, $1,436; Manchester, 250 cases electrical material, $2,500; 8 cases electrical machinery, $730; Moscow, 8 packages electric motors, $730; Naples, 3 cases electrical machinery, $425; Peru, 24 cases electrical material, $937; Preston, 6 packages electrical material, $500; Santo Domingo, 3 cases electrical material, $59; Southampton, 2 cases electrical machinery, $24; U. S. of Colombia, 8 packages electrical material, $2,132—12 packages electrical mamachinery, $651—2 cases electrical material, $235; Vallorbes, 3 cases electrical material, $125; Venezuela, 41 cases electrical material, $83; Zurich, 5 packages electrical machinery, $1,003.

Lighting and Traction Deal at Charleston S. C.

A special despatch from Charleston, S. C., of Jan. 20 says: Interested parties here confirm the announcement made yesterday from Baltimore that the Charleston City Railway Company, the Seashore Railway Company, the gas company and the electric light company of this city were all to be consolidated under one management. The deal is being engineered by the Baltimore Trust and Guarantee Company, and the new company will have a capital stock of $2,500,000. Securities of the four companies were being turned into the special committees appointed to receive them, and their holders all express themselves satisfied with the prices paid for shares. It is believed here that after the consolidation has been completed a number of new enterprises will be started by the company.

TACOMA, WASH. The Central High School is to take current from the Railway Co. for experimental purposes.

A FOUR YEAR OLD BOY was given a verdict last week for $23,000 against the Brooklyn Heights Company. A trolley car cut off one leg at the knee and the toes of his other foot.

MARRIED

Oscanyan—Stone.

The marriage of Mr. Paul C. Oscanyan and Miss Elsie Clifford Stone, daughter of Mr. and Mrs. C. F. Stone, of 17 West Twelfth street, took place on the evening of Jan. 18 in All Souls' Unitarian Church, Fourth avenue and Twentieth street, New York City. Miss Laura Lowrey Stone, a sister of the bride, was her maid of honor, and the bridesmaids were Misses Lisa Van Rensselaer, Jane Faile, Minnie Stone, Caroline Timpson, Jaidee Hayner, of Toronto, and Mabel Andrews. Charles Francis Stone, Jr., was best man, and the ushers were J. K. Porter Stone, Kenneth Leslie Fleming, Jr., Humphrey Swift, and Percy O'Connor. The groomsmen were Dr. Walter Power, Percy Ingalls, Dudley Farrand, Daniel C. Stanwood, John R. Fellowes, and Stephen Millett. The bride was gowned in white silk, trimmed with point lace. The Rev. Thomas R. Slicer, pastor of the church, officiated. A small reception followed at the home of the bride's parents. Mr. Oscanyan, who is well known in the electrical field, holds a responsible technical position with the Peoples Co., of Newark, whose plant was described in The Engineer of Jan. 5.

PERSONAL

Mr. L. H. Rogers.

Mr. L. H. Rogers has resigned from his position as treasurer and general manager of the Fort Wayne Lamp Co., 47 East Prospect street, Cleveland, O., to take up the active duties of the Oklahoma Cement & Plaster Co., as treasurer, to which position he was elected at their annual meeting in Kingston, N. Y., January 2.

It was while Mr. Rogers was assistant general manager of the Brush Electric Co. that his attention was called to a natural deposit of cement in Oklahoma Territory. He visited the ground in company with Mr. E. J. Bagnall, now of the Adams-Bagnall Electric Co.

Mr. Bagnall, as an engineer, pronounced the deposit as quite valuable and worthy of development. A history of this material, its discovery, manipulation and uses would make an interesting story in itself. It was in 1894 when Messrs. Rogers and Bagnall first visited the cement beds; since that time the company for its development has been formed, all the surrounding "cement" prospects have been secured, as quietly as possible, and a mill erected for treating the stuff for the market.

The principal use to which the material will be put will be as a wall plaster, as it makes a wall as solid as a rock, absolutely fire and waterproof, and entirely free from any expansion or contraction, preventing the cracks so annoying to house builders using the ordinary mortar. The trade name will be "O. K."

The head office of the Oklahoma Cement and Plaster Co. will therefore be in charge of Mr. Rogers, with headquarters in Cleveland, and from this point the exploiting of the business will be done over the entire country. Cleveland is chosen as being centrally located. The names of the officers are as follows: Hewitt Boice, president, Kingston, N. Y.; Ira Mowery, vice-president, Tarrytown, N. Y.; L. H. Rogers, treasurer, Cleveland, O.; W. M. Burhans, secretary, Okarche, O. T.; E. J. Bagnall, consulting engineer, Cleveland, O.

MR. JAS. S. ANTHONY, formerly in charge of the publication and advertising department of the Walker Co., has now been named as assistant to Mr. F. E. Drake, head of the electricity and machinery department of the American Commission for the Paris Exposition of 1900. Mr. Anthony will have his headquarters in New York city at the commission offices in the Equitable Building.

PROF. S. H. SHORT, now traveling in Europe, has a very interesting article in the January "Cosmopolitan," in which

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he describes the traction advances of the past fifteen years, and predicts that the next fifteen will probably see electricity in use on many of the trunk lines.

MR. RICHARD CROKER, JR., is taking a course in practical electricity at the Westinghouse electric shops at East Pittsburg.

MR. S. G. COLEMAN, superintendent of the lighting department of the Milwaukee Electric Railway & Light Co., has been presented by his colleagues and men with a handsome Masonic diamond pin on the occasion of his retiring from that service.

COL. EUGENE GRIFFIN has been nominated as Brigadier General by the President. The promotion has been earned by signally successful work in raising and leading valuable troops during the war, in a way that none but an accomplished West Pointer could do.

REPORTS OF COMPANIES

Columbia Incandescent Lamp Co.

At the annual meeting of the Columbia Incandescent Lamp Co., St. Louis, Mo., Mr. W. O. Garrison was elected president, Mr. A. C. Garrison vice-president and treasurer, and Mr. Geo. P. Rex acting secretary. The last named has been manager of the Chicago office hitherto, but now assists at headquarters. Mr. W. O. Garrison will not take any active part in the management of the company, but serve in an advisory capacity. Mr. A. C. Garrison, who has always been so active and prominent in the affairs of the company, will still have charge of the general management of the company as vice-president, etc., as above noted.

The company has just issued a superb new catalogue in rich Venetian red cover, devoted to their lamps. It is handsomely printed, and the lamps are shown by choice half tones, full size, accompanied by descriptive text. Everything is revealed in the utmost clearness of detail, and a great variety is given covering all the branches of the incandescent lighting art. There is also a full page of illustrations of the different bases in use, and the last page is devoted to an excellent view of the factory.

Mr. A. C. Garrison was a recent visitor to New York, but had to leave for home quickly on account of rush in business.

Selling Out the Edison Elec. Ill. Co. of New York City.

IT was officially announced last week that provisional arrangements had been perfected for the sale of the Edison Electrical Illuminating Co., of this city, to the New York Gas & Electric Light, Heat and Power Co., better known as the Electric Trust, with a capitalization of $25,000,000 and controlled by William C. Whitney, W. L. Elkins, P. A. B. Widener, Thomas Dolan and Thomas F. Ryan.

The circular letter sent to the stockholders of the Edison Co. by Spencer, Trask & Co., Vermilye & Co. and the Central Trust Co., says: "Mr. George Foster Peabody, of the firm of Spencer, Trask & Co., representing the principal stockholders of the Edison Co., has entered into an agreement with the State Trust Co. for the sale of the Edison stock, represented by him, to become binding only in case the holders of at least 55 per cent. of the stock shall have agreed to the sale by Feb. 15, 1899, with an allowance of ten days additional to stockholders living abroad.

"Up to these dates the stockholders will be privileged to join in the sale on the same terms, namely, 220 per cent. of the par value of Edison stock, payable in 4 per cent. purchase money gold bonds due Feb. 1, 1949, of the New York Gas and Electric Light, Heat and Power Co. at par, that company to have the right to pay off the bonds at par and accrued interest at any time within three years from Feb. 1, 1899.

"The issue of bonds is to be limited to $21,000,000. They will be secured by a purchase money mortgage, which will be a first lien on the Edison shares and by the deposit of $4,000,000 in cash with the trustee, the Central Trust Co., of New York (with reserved power to invest the same in improvements or extensions of the Edison plant and property), and by a second mortgage upon the property and franchises of the Power Co., subject to a first mortgage securing $15,000,000 bonds, of which $11,500,000 are now outstanding."

The New York Gas and Electric Light, Heat and Power Co. has been organized with the intention of obtaining a controlling interest in the lighting and power business of this city, and is said to be planning to use the surplus electricity from the new power plant of the Metropolitan Street Railway Co. The Edison Co. has the largest plant of all the electrical illuminating companies in the city. Its absorption gives the Electric Trust control of all the electric lighting companies in the city except the Edison Electric Illuminating Co. and the Consolidated Westinghouse Co.

The companies which have already been absorbed are the Mt. Morris Electric Light Co., the Manhattan Electric Light Co., the Edison Electrical Illuminating Co. and the Consolidated Telegraph and Electrical Subway Co.

The transfer of the stock to the Whitney syndicate has not been without opposition, led by Mr. R. R. Bowker, first vice-president, who is the active executive of the company. Mr. Bowker is opposed broadly to trusts and combinations, and when negotiations were begun he absolutely refused to be a party to this one. When he found that a majority of the stockholders favored the deal he wrote a letter to the directors tendering his resignation. This letter was dated Dec. 22, and said that the resignation would become effective as soon after Dec. 31 as Mr. Bowker could complete his annual report and turn over his work to his successor. The resignation of Mr. Bowker is a cause of much regret to the Whitney syndicate. Assurances were given him that his interests would be fully protected, but he declined to reconsider his action. Mr. Bowker declines to discuss the matter further than to say that he had sent in his resignation because he opposed the transaction as unnecessary and undesirable. He said he did not intend to deposit his stock.

Annual Meeting of the Chicago Bell Telephone Co.

At the annual meeting of the Chicago Telephone Co. Jan. 19 the figures on the business of the past year showed a general increase over those of 1897. Gross and net earnings were larger, and the surplus for the year, after paying 12 per cent. dividend, or $520,380 on the stock, was $113,572, as against $104,313 the preceding year, and the officers report the company in better position than ever.

The following figures show the business of the company in 1898 and a comparison with the business of 1897:

	1898.	1897.
Gross earnings	$2,307,959.88	$2,072,079.55
Expenses	1,674,007.60	1,447,386.08
Net earnings	$633,952.28	$624,693.47
Dividends paid	520,380.00	520,380.00
Surplus for year	$113,572.28	$104,313.47

Capital stock outstanding Jan. 1, 1899, $4,336,500.

Vicissitudes of the Strowger Automatic Telephone.

A special despatch from Milwaukee of Jan. 13 says: President McKinley has inadvertently made trouble for the Strowger Telephone Exchange Co. It all comes from the fame which was brought to an instrument which the Strowger Co. put in at the White House and the residences of Cabinet officers during the war, and by which the President was enabled to talk with his official advisers without any one being the wiser.

A suit, which has been brought before Judge Jenkins in the United States Court here, was instituted by the Automatic Telephone Exchange Co., Ltd., that had an option to sell the foreign patents for the Strowger Co. This option has expired, it is claimed, and now the plaintiff asks that the defendant be forced to grant an extension on the ground that the work done by the plaintiff was for the benefit of the defendant.

It is claimed that up to the time of the recent war the invention was slow of adoption, but that the advertising given the instrument through its use by the President has given it a boom

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in England, where the plaintiffs were operating, and where it is asserted the patent right is now worth at least $500,000.

The suit was brought in the Circuit Court for the Northern District of Illinois, but Judge Jenkins is hearing it here. Some of the most prominent members of the Chicago bar are interested on one side or the other, including Judge Musgrove, Judge Smith, Judge Hamlin, Judge Davis and L. M. Hosea.

Amual Meeting of Central Union Telephone Co.

The annual report of the Central Union (Bell) Telephone Co. for 1898, presented at the annual meeting on Jan: 19, showed an increase of business and an increase of earnings over 1897. The net revenue for the year was $306,337, as against $287,799 in 1897. Following are the comparative figures:

	1898.	1897.
Gross earnings	$1,667,167.55	$1,439,001.44
Expenses for administration, operating, maintenance and interest	1,360,829.65	1,151,201.77
Net revenue	$306,337.90	$287,799.67
Surplus	306,337.90	235,627.41
Added to construction account at exchanges	523,610.81	327,086.66
For toll lines	365,137.12	457,105.87
Totals	$888,747.93	$802,192.53

The amount charged to maintenance during 1898 was $120,000 greater than in 1897. The money was expended in renewing the old plant, both in lines and stations.

There was no talk at the meeting of paying a dividend, and the large owners of stock do not contemplate paying one till the company has been built up to a much stronger position.

Westinghouse Plans for Capturing European Trade.

The Westinghouse Electric and Manufacturing Co. will begin this year, says the Pittsburg "Times," the organization of many companies throughout Europe to capture the growing electrical trade. Plants will be established in all the countries so organized, but until this is done all contracts secured will be filed at the East Pittsburg works. The company has already organized a company in France, and has captured the big Metropolitan order there, and Treasurer Philip F. Kobbe has left for London to assist in perfecting the organization of others. An immense foreign trade is expected as a result.

Vice-President Lemuel Bannister, who was formerly at East Pittsburg, went to London a year ago to look over the ground and prepare for the organization of the companies. The English company, which had been organized several years ago, was greatly enlarged by the establishment of numerous agencies throughout the kingdom. Large companies are now in process of formation in Germany and Russia, and the outlook for large electrical contracts there is so bright that it is expected that plants will be erected before long. The control of the companies will be held by the Pittsburg company, and the foreign companies will be allowed the use of the patents controlled by the local concern. Companies will also be established in Italy, and probably on the north coast of Africa. The Westinghouse Company expects to secure all the important work, or at least the bulk of it, by its new idea of expansion. Its methods and machinery are so far in advance that it is believed great success will follow its efforts abroad. The English and other work will still be done in Pittsburg whenever it is possible to do so, as the economies secured here are far in excess of those abroad.

Vice-president Bannister has entire charge of the expansion work, and the visit of Treasurer Kobbe will be simply to look over the results so far attained. He will return in six weeks.

Bell Telephone Mergers.

Although local telephone officials are not, as yet, disposed to do much talking about the plan that is in hand for merging the Bell Company into the American Telephone and Telegraph Company, as was outlined in this column, says the Boston "Journal," it is nevertheless known on excellent authority, that the facts as given are correct and that in due time—possibly within 60 or 90 days—formal announcement of the project will be made. It is largely the news of this plan and the benefits that will accrue to the stock, in the way of rights, that is inducing much of the present buying and that is lifting the price of the stock to its highest level on record. The outstanding stock of the American Company is held almost wholly by the Bell people. Indeed, the two corporations are even now practically one, excepting in name. The American Company—a New York corporation—with its extensive long distance service, makes a most valuable asset for the Bell Company, and the right to take its stock at par by the Bell stockholders will of course be a very desirable plum.

In connection with this proposed transfer, it now transpires that the American Company will not only absorb the Bell Company, but is planning also, at some time in the future, to take in as well all the sub-companies of which it has a majority control. Indeed, it is claimed now that when the company was first organized its purpose was not only to build long distance telephone lines, but that it was intended to ultimately absorb all the subordinate corporations when the proper time should come. And it is on good opinion that the Bell people have now started in on the consummation of this plan and that when it is done the American Company will not only be in control of the companies of which it now holds a majority of the stock, but that it will also, by purchasing control of the others, hold possession of every telephone company in the country. The "deal," according to good authorities, is a big one, and its consummation will, of course, require much of time and much of careful planning.

Cass & Company.

Mr. Philip Cass, recently connected with the Cass & Aaron Co., of Chicago, has recently resigned all connection with them and has opened a handsome suite of offices under the name of Cass & Company, in the Machinery Hall, 54-60 S. Canal street, Chicago. Cass & Co. will handle new and second-hand dynamos and motors, and all electrical supplies relative thereto. They will also conduct a general repairing business and have a plant particularly adapted for rewinding armatures and fields, refilling commutators and general repairing of dynamos and motors, arc lamps, transformers, and, in fact, all apparatus relative to the electric light anr railroad business. Mr. Cass will be glad to see all of his friends at his new office, where they will be assured a hearty welcome.

The Rising Tide of Activity.

The past week has been one of the most active that this country has seen in many years, not merely in the field of speculation and investment, but in the various branches of trade, commerce and industry. In fact, the present speculation in Wall street, which has outrun all former experience, does but indicate the growing industrial prosperity, which bids fair to last at least three or four years, and may develop into a long period of general well doing, despite the inevitable reactions. Just now, in the stock market, while reactions are talked about, they are not large, and, in the opinion of many leaders, the upward movement is but at its beginning. If stocks were carried by weak holders, they might go down, but there is little increase in bank loans, showing that stocks and bonds are being bought outright and salted away. The money market could not well be easier, and even the rapidly growing demands of trade and manufacture make slight impression on its elasticity and resources.

During the past week 28,615 shares of Western Union have been sold, closing at 95½. General Electric was very strong on small sales, rising to 102¼ on 9,740 shares. New York Edison closed at 198: the new deal exchanges stock for 4 per cent. bonds at 220. Metropolitan Street Railway was steady around 198-9, on sales of 49,405 shares. In Boston, Am. Bell Telephone had a phenomenal rise on reports of removals and consolidations, going up 28 points, from 285 to 313 on sales of 5,000 shares. Further gains are looked for. West End Railroad was strong at 94.

Copper this week went up to 14½ cents, New York. A big

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copper deal is still spoken about freely. Heavy steel rail Eastern mill is $18.50 per ton. Iron and steel bid fair to become scarce, owing to the extraordinary demand.

OBITUARY

Gen. S. E. Marvin.

A special dispatch from Albany, of Jan. 19, announces the death there that day of Gen. Selden E. Marvin, a prominent citizen of Albany, president of Hudson River Telephone Co., and a member of the State Board of Charities. He was prominently connected with the iron industry in the vicinity for many years, being associated with his brother-in-law, the late Erastus Corning.

CATALOGUES.

The Reeves Wood-Split Pulley.

Well known as this apparatus is, a useful booklet describing the same has just been issued by Patterson, Gottfried & Hunter, Ltd., 146-150 Centre street, New York. Six sound reasons are cited why the Reeves is the best wood-split pulley on the market, and after reading them one becomes convinced that the claims of the company are not extravagant. The book also contains chapters on the "loss of power," step and bevel cones, tight and loose pulleys and the approximate weights of each. There are also a number of rules for calculating the sizes and weights of split wood pulleys. Most of the body of the book is left blank so that it can be used for a pocket notebook. Thus this little booklet becomes of considerable value and certainly worth sending for.

"DRAFT WITHOUT A CHIMNEY." In its interesting and attractive circular thus entitled, the B. F. Sturtevant Co., of Boston, Mass., tell why its tall chimney has been taken down, how draft is now produced, and how an annual fuel saving of nearly $1,000 is secured. This information may be had for the asking.

A FISH STORY is the caption to an engraving on a calendar now being distributed by C. R. Fish, 71-73 Broad street, Boston, Mass. It represents an old Cape Cod fisherman recounting some piscatorial yarn to a more youthful assistant. In the margin of the card are shown several finny inhabitants of the deep, and a suggestion to order station supplies from the sender is also conspicuous. Another calendar is issued by the same house consisting of a handsomely embossed bust of a maid with one elbow resting on a large shell. On the latter is the name of the concern and the calendar proper.

NEW YORK ELECTRIC MACHINE CO., of Buffalo, has been formed with a capital stock of $10,000. The directors are J. Tate and F. Wardell, of Buffalo, and Thos. E. King, of Arbel, Pa.

ELECTRIC APPLIANCE TELEPHONES. A telephone a little better than anything else on the market is a pretty hard thing to build, but the Electric Appliance Co. claim that they have succeeded in doing this in their No. 11 instruments. They are backing up their claims with a very liberal offer which telephone companies will do well to study.

CHICAGO, ILL. The United Telegraph, Telephone & Electric Company has obtained a loan of $500,000 from the Chicago Title & Trust Company for twenty years at 6 per cent. interest. It is to secure a bond issue.

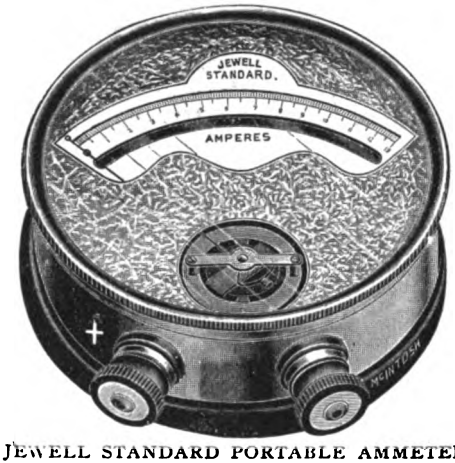
TRADE NOTES AND NOVELTIES

The Jewell Standard Meters.

A VERY reliable and attractive line of portable volt and ampere meters has recently been placed on the market by the McIntosh Battery & Optical Co., 521 Wabash avenue, Chicago. It has been the aim of the company to offer to the public a meter which will be both durable and accurate. The construction is exceedingly rigid, fitting it to withstand the rough usage to which portable instruments are frequently subjected. It is of the d'Arsonval type, having a coil moving in the field of a permanent magnet.

It is dead beat, and has uniformly spaced scale divisions. It has an adjustable dial, so that should the index become bent it is but the work of a moment to set it to zero.

The permanent magnets are made from imported magnet steel, and are thoroughly aged before being placed in the instrument. The springs are made by the company of special low resistance phosphor bronze alloy, and have an exceedingly fine temper. The series coils in the voltmeters, and the shunts of the ampere meters shown above are made from an alloy having a zero temperature co-efficient. A neat hardwood carrying case is provided with each meter. The voltmeters have a resistance of about 120 ohms per volt of scale—i. e., a 0 to 150 voltmeter has a resistance of 18,000 ohms.



THE JEWELL STANDARD PORTABLE AMMETER.

The scales of the instruments are hand drawn from recognized standards.

The milliampere, ampere, volt and millivolt meters are now made for eighteen different ranges, all of which are described in the company's catalogue, which will be sent to any one on application.

Williams Electric Co.

MR. BURT HUBBELL, formerly of the Keystone Telephone Co., of Pittsburg, and later with the American Eelectric Telephone Co., of Chicago, has recently associated himself with the Williams Electric Co., of Cleveland. Mr. Hubbell is one of the pioneer "independent" telephone men, dating his experience from 1890, when he built the first opposition telephone exchange in the country. Since then he organized the Keystone Telephone Co., and was largely instrumental in its rapid advancement. Since the consolidation of that company with the American Electric Telephone Co. Mr. Hubbell has had charge of the business at Chicago.

The well known ability of the Williams Electric Co. to manufacture a superior grade of apparatus in the telephone line, coupled with Mr. Hubbell's knowledge of the telephone trade—that is, what to sell, how to sell, to whom to sell, makes a combination that will be eminently successful in the telephone business.

This company has hitherto confined its product to magneto

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bells and receivers, and their success in producing high grade work of this nature has been so pronounced that they have recently got out a long distance solid back transmitter which they claim to be superior, and they are now going to sell complete telephones and switchboards.

Sturtevant Motor and Fan.

IN the accompanying illustration Fig. 1 is presented a type of fan which has recently been constructed by the B. F. Sturtevant Co., Boston, Mass. The shell of the fan is one belonging to their regular 60-inch steel plate exhausters. The motor is of the four-pole type, the same as the regular independent motors and generators built by this company, and is complete with its supporting bed. This bed is raised to the proper level by a very substantial steel plate base attached to the fan side.

The field ring and pole pieces of the motor are of cast steel, and the pole shoes of cast-iron. The armature, Fig. 2, is of the barrel-wound type, and provided with a cast-iron flange bolted

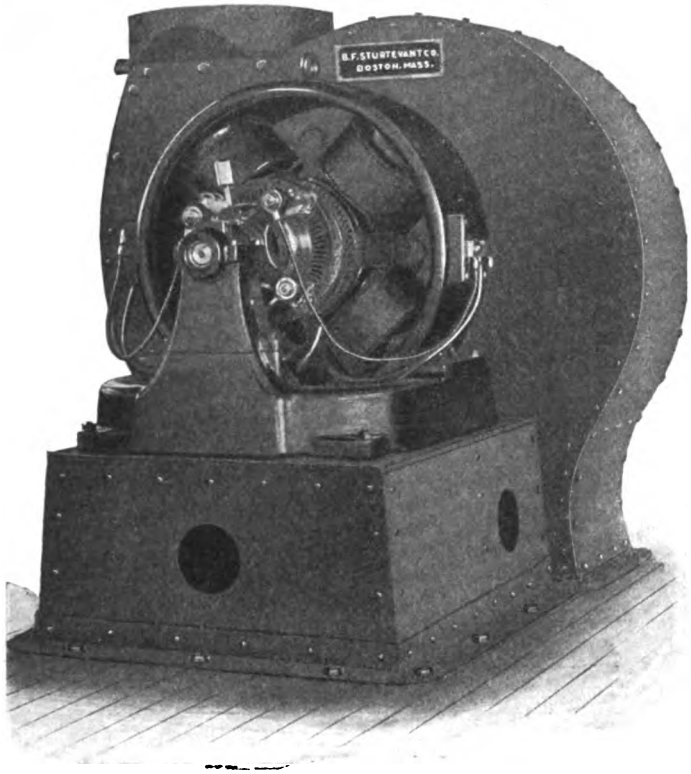

FIG. 1.—STURTEVANT FAN AND MOTOR.

to the spider at each end of the core, thereby forming a support as well as a cylindrical receptacle for the projecting ends of the coils. This flange casting also protects the windings from any oil that may be thrown from the bearings. The surface of the interior of the armature flange is perfectly smooth, offering no opportunity for collection of oil or dust.

The ventilation is effected by the use of specially constructed

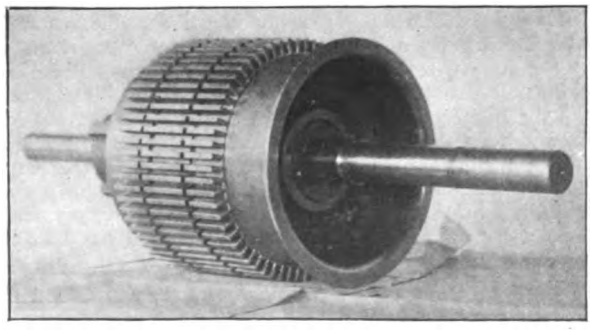

FIG. 2.—ARMATURE OF STURTEVANT MOTOR.

vanes forming air ducts between the laminae of the core. This converts the armature into a blower, and creates a strong draft through the windings. The design of the machine is such as to insure absolutely sparkless operation under all changes of load from no load to 25 per cent. overload. The temperature rise after a full load run of 10 hours does not exceed 90 deg. F. The bearings, which are ring oiling, are built upon the ball and socket principle.

Combination Sign of the Prismatic Electric Sign Company.

WE illustrate in our advertising pages a new prismatic electric sign, which is being put upon the market as their No. 5, by the Prismatic Electric Sign Co., of Williamsport, Pa. It is a combination of two signs, the upper sign being the same as their Standard 28 in., and may contain clocks as desired. These clocks are genuine timekeepers, and will run from 8 to 12 days with one winding. The clock's dials have heavy plate glass and the hands and face are protected by another double thick glass on the outer rim. Each side has double hinges and the drum has a hand-hole at the side for winding. The number of lamps, and the color effects in the clock case are the same as in the 28-in. Standard, which have eight 16 c. p. lamps with four distinct colors and combinations. The finish of this specialty is black iron, and the case is made dust and waterproof. The clock case is supported by another sign with glass 18 x 30 inches, the frame being finished in black and relieved in white enamel showing two sides. It contains eight 16 c. p. lamps with a maximum burning of eight 16 c. p. lamps.

The automatic service switch which runs the sign is so adjusted that the face of the clock and the face of the lower sign are always of a different color or combination of colors, making the sign doubly attractive. For instance, when the clock is green the lower sign is violet; then instantly changing, the clock to red and the lower sign to orange. The two signs are mounted on a base under which are fastenings for a post, which post can be afterwards set upon the side wall and may carry any lettering in black and white which may be desired.

The Triumph Electric Co.'s New Dynamo.

AN interesting new dynamo, herewith illustrated, has just been brought out by the Triumph Electric Co., of Cincinnati, O. This dynamo, the makers claim, will develop current

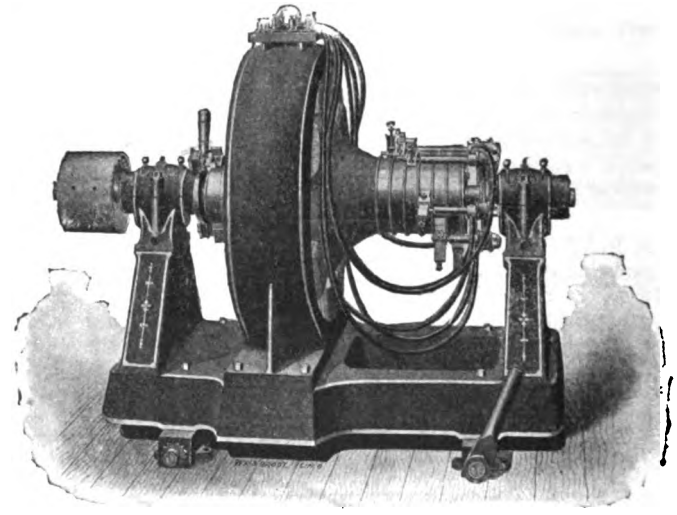

FIG. 1.—NEW TRIUMPH DYNAMO.

for 50 per cent. more lights than the most modern and efficient machines; or vice versa, will develop current for the same number of lights with the expenditure of only 35 per cent. of the energy required with any other machine.

This invention is analogous to that of Corliss in the steam engine field, the result being obtained by using the current expansively, so to speak. The generator is multipolar, the armature windings being divided into distinct and separate circuits connected through a special commutator to separate distributing circuits with a common return, as shown in the accompanying diagram. The initial voltage generated in each circuit is 220 volts, this current being generated in each circuit for only one-third of the time, or, in other words, each coil on the armature is active for only one-third of a revolution, being entirely cut out of circuit for the remaining two-thirds. Actual test has dem-

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onstrated that when a rate of 5,400 impulses per minute has been reached the light is absolutely steady.

A recent test of a 300-light machine of this type waas made as follows: Two new 16 c. p. 110-volt 55-watt lamps were selected at random from a barrel of Buckeye lamps. These were placed at each end of a Bunsen photometer. One was connected to the mains of a direct current machine, and held at 115 volts; the other was connected with the dynamo being tested. The Bunsen disk was placed in the centre of the scale, and the current from the dynamo under test was regulated with a field rheostat until the lamp on that circuit was brought to the same candle power as that on the direct current.

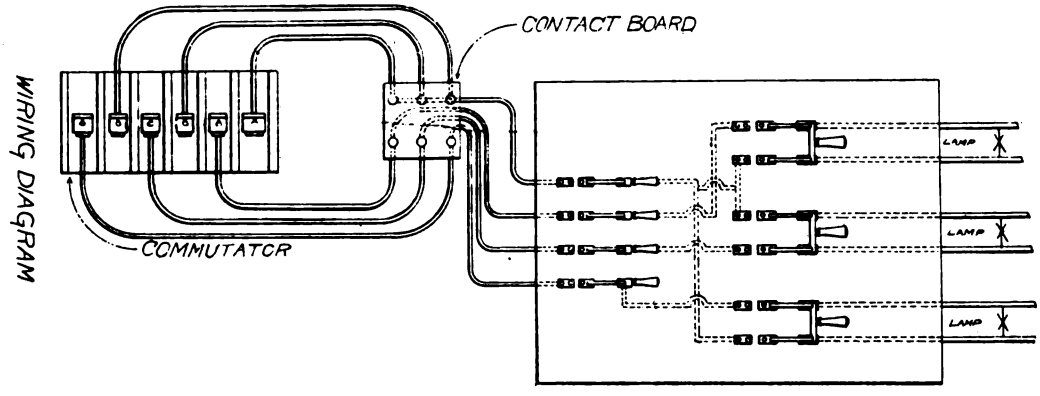


FIG. 2.—NEW TRIUMPH DYNAMO AND CIRCUITS.

All readings were taken with Weston portable voltmeters when the candle power of the lamp on what we will call the "interrupted current" generator was exactly the same as that on the direct current, the apparent voltage of the interrupted current was observed and the test began, the results being given below:

The dynamo was belted to a countershaft, driven by a 12x14 automatic engine.

Average of 3 cards, 33.35 h. p. No. 16 c. p. lamps 304.

Average of 3 cards 24.43 h. p. No. 16 c. p. lamps 152.

Average of 3 cards 13.82 h. p., fields open.

No. 16 c. p. lamp per h. p. delivered at full load 15.56.

No. 16 c. p. lamp per h. p. delivered at half load 14.32.

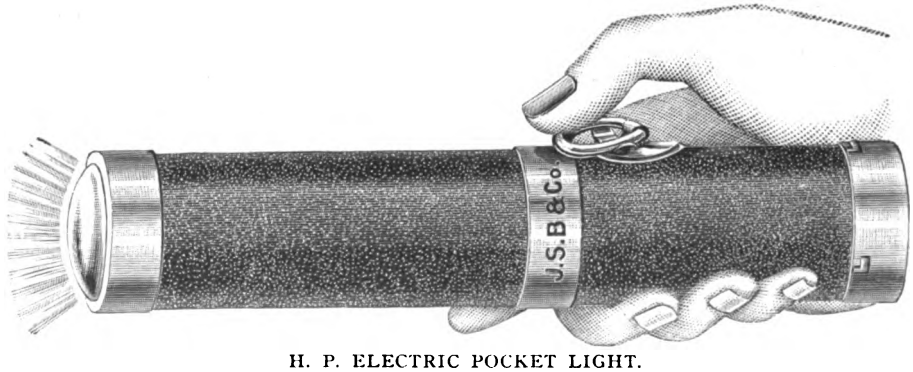
It is observed by the builders that these results are fully 50 per cent. better than can be expected from any standard machine of the same capacity, also that there is a surprisingly small drop in efficiency at half load.

The manufacturers state that they are ready to furnish a limited number of sizes at present, and to put them in on trial, permitting the machine to talk for itself. The machines are, as will be noted, very simply and compactly built.

For further information The Triumph Electric Co., Cincinnati, Ohio, should be addressed. Their announcement on the subject appears elsewhere in this issue in our advertising pages.

H. P. Electric Pocket Light.

JAMES S. BARRON & CO., 24-30 Hudson street, New York, dealers in general electric supplies, are putting on the market a very useful specialty called the H.-P. Electric Pocket Light. It is designed for use in a great many directions, for electricians, engineers, machinists, miners, physicians, watchmen, policemen, yachtsmen, in fact, for all purposes where a safe and handy flashlight is desired. It is of portable size, and weighs a little more than one pound, and can be comfortably carried in the pocket. It is guaranteed by the makers to give approximately eight thousand lights, or "flashes," of appreciable duration before the battery requires renewal. The batteries are of the dry kind, and the lamp contains three of them, with a capacity of over three volts. At the end of the lamp is a magnifying lens, as shown in the illustration, for the purpose of distributing the light. Its varied uses, especially in the domestic line, where the employment of matches is dangerous, or in warehouses where explosive articles are stored and a thousand others, make this portable light a good salable article, and at present we are informed that the demand for this portable light is enormous and constantly growing. J. S. Barron & Co. would be pleased to send descriptive circulars, etc., regarding this pocket light to any address on application.



H. P. ELECTRIC POCKET LIGHT.

Utica Elec. Mfg. and Supply Co.

At the annual meeting of the Utica Electrical Manufacturing & Supply Co. the following were elected directors: William E. Lewis, Jesse Brayton, W. H. Cloher, Jr., Frank S. Ferris and William C. Ballda; Inspectors of Election, H. B. Sweet and H. M. Scheuch. At a subsequent meeting of the directors Mr. Lewis was elected president, Mr. Cloher vice-president, and Mr. Brayton secretary and treasurer.

Ward Leonard Automatic Circuit Breakers.

The Ward Leonard automatic circuit breakers have been meeting with the recognition which is always accorded by the electrical trade to high class apparatus having meritorious features and selling at a moderate price. The electrical engineers throughout the country have been quick to appreciate the importance of the two independent switches, separately closed, but simultaneously opened upon overload by the automatic device. This feature not only makes it impossible to do any damage to the dynamos or circuit breakers by overload current in closing the circuit breaker upon a short circuit, but it entirely eliminates the necessity of the knife switches which the former types of circuit breakers required, in series with them.

The amount of money and space saved by this important feature makes this circuit breaker always a favorite with the electrical engineers who are acquainted with the point. The inde-

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pendent hammer blow used to assist the springs in opening this circuit breaker is also an important feature which wins great favor. The Ward Leonard Co. are busy upon important orders for circuit breakers for concerns whose electrical engineers are recognized as the leaders in the electrical engineering profession, and their business in this line is growing with astonishing rapidity. The United States navy has specified the Ward Leonard circuit breakers upon all of its recent work. As the standard of the United States navy in electrical matters is the highest standard in the world, the quick adoption of this circuit breaker by the navy is the highest possible endorsement of it.

ADVERTISERS' HINTS

EUREKA ELECTRIC CO., 157-159 Canal street, Chicago, Ill., ask that their switchboards and telephones be judged by their finish and the material as well as workmanship. They are ready to make quotations on anything in the telephone line.

HART & HEGEMAN MFG. CO., Hartford, Conn., call attention to the fact that all Hart switches have the words "Hart Switch" stamped in the metal. They say that by this means buyers may be sure of knowing when they get the genuine.

I. P. FRINK, 551 Pearl street, New York City, advertises his combination cluster reflector as a perfect fixture for office and public buildings, hospitals, etc. This reflector is lined with Frink's silvered, corrugated mirror, or opal glass, in sections, which are set in solid metal frames. The diameter of the reflector is 20½ inches, and the length is 30 inches. He also informs us that he has been licensed to manufacture electric and combination fixtures.

THE ELECTRIC STORAGE BATTERY CO., Drexel Building, Philadelphia, Pa., have moved their San Francisco office from 10 Front stret to the Parrott Building of that city.

THE FUEL ECONOMIZER CO., Matteawan, N. Y., state that power stations, whether for electric supply or electric traction, are only complete when equipped with the Green Economizer. Their catalogue is ready for distribution.

WHEELER REFLECTOR CO., Boston, Mass., while not wishing to enter into elaborate details regarding the workmanship and materials which have made Wheeler Reflectors so successful, simply say that both are the best that can be procured.

MANHATTAN GENERAL CONSTRUCTION CO., 11 Broadway, New York City, to close out the balance of their old type lamps, are offering 200 Manhattan D. C. lamps at $12.00, and 50 Manhattan Junior lamps, 3 amperes, at $11.00. They say, however, if the best A. C. and D. C. enclosed arcs on the market are desired, to use the new type Manhattan. They also supply electric projectors and photo-engraving lamps.

GARVIN MACHINE CO., Spring and Varick streets, New York City, have just issued a new catalogue of machine tools and automatic and special machinery.

NEW YORK NOTES.

BAKER & CO. have removed their well-known New York offices on Liberty street across the way to 120, in the Beard Building, where Mr. C. O. Baker, Jr., is now located in a choice and cheerful suite, where all old friends and acquaintances are made heartily welcome.

BROOKLYN, N. Y. Mr. Connelly has introduced a resolution in the Borough Council to abolish all street electric lights and substitute Welsbach or other burners instead.

MR. F. V. T. LEE, engineer for the Stanley Elec. Mfg. Co. on the Pacific Coast, with Mr. John Martin, their agent in San Francisco, was in New York last week before returning home. He has been making a general trip through Canada and the East.

STATEN ISLAND. The Staten Island Electric Company has been introducing the meter system, and has been getting into hot water with customers who have held flat contracts, and from whose places wires and lamps have been taken out. The consumer is also required to pay for all lamps. The new scale made a reduction of 25 per cent. in price of current, making it from 20 to 15 cents and lower per k. w. hour.

EVANS PNEUMATIC MOTOR CO. has been formed under the laws of New Jersey with a capital stock of $30,000, of which $1,000 is paid up. The object is to make and sell pneumatic motors and other mechanical or electrical devices. The incorporators are J. R. Cotton, J. H. Witsil, of Chester, Pa., and S. W. Sparks, of Camden, N. J.

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The Electrical Engineer.

Vol. XXVII. FEBRUARY 2, 1899. No. 561

NEWS & NOTES

Electroplating the Hulls of Vessels.

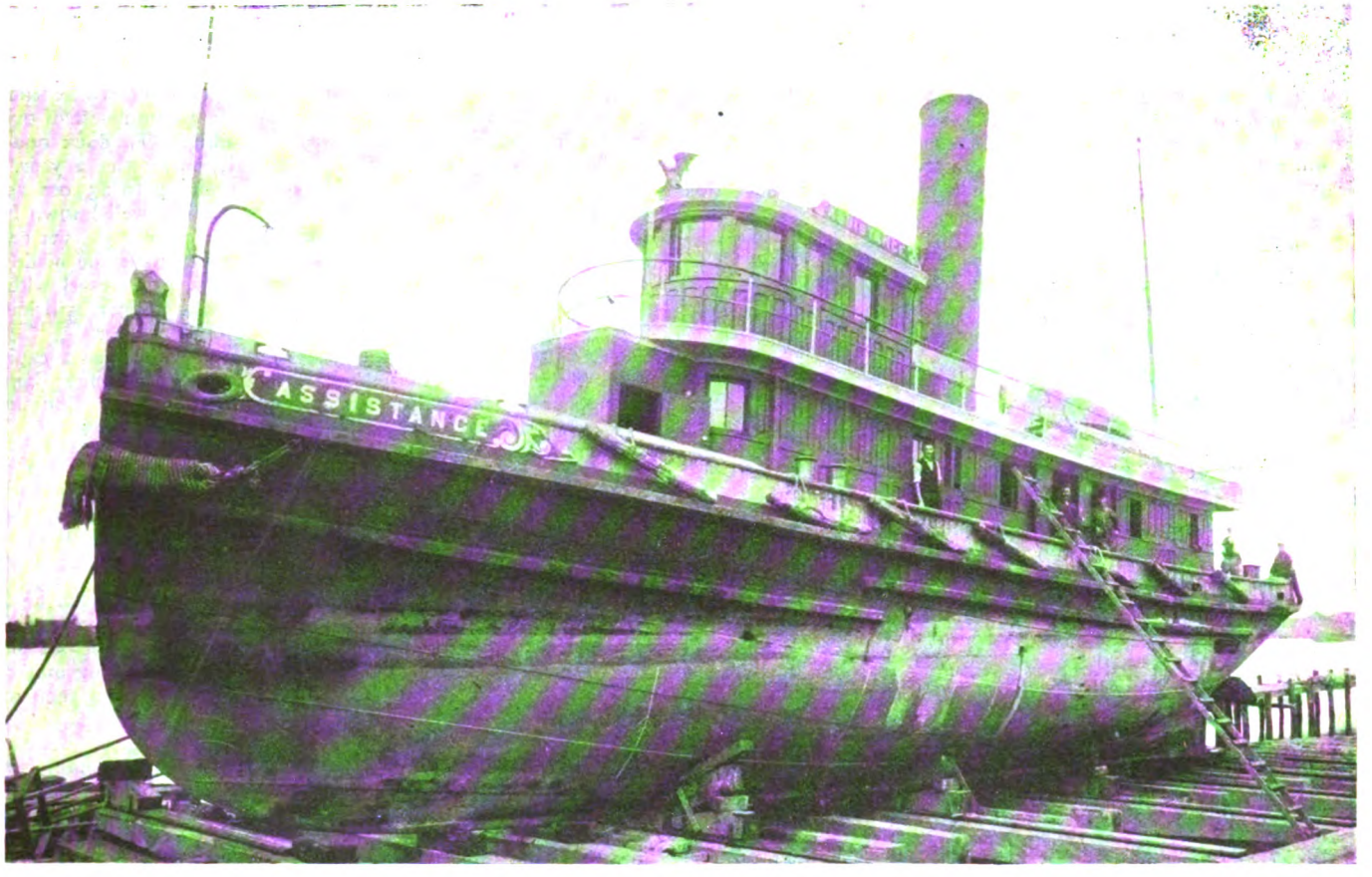
AFTER a series of professional and critical tests covering a period of nearly four years on the efficacy of the system of copper plating the hulls of vessels invented by Mr. Thomas S. Crane, a favorable report has finally been rendered to the U. S. Government by Naval Constructors Bowles and Rock, U. S. N.

The craft which has been under test is the tug "Assistance," shown herewith, an ocean-going boat. She was electroplated and launched on Feb. 22, 1895. The work was done on a marine railway in Jersey City. A few days ago the "Assistance" was hauled out of the water on a dock opposite the Norfolk Navy Yard. At the latter place she was subjected to a critical examination. The vessel's bottom was found to be absolutely free from barnacles or marine growth of any kind. For the year just past she has been towing in the lower waters of the Chesapeake, and, while other tug boats made it a practice to haul out to clean bottom every four weeks the "Assistance" remained constantly at work. She early gained the reputation of being the fastest tug in and about Norfolk.

The reports made on the "Assistance" go into minute details. In addition to the examination of the naval officers, reports were made by Mr. A. A. Knudson, electrical engineer, and Prof. W. J. Comly, the electrical chemist. Both Mr. Knudson and Prof. Comly are enthusiastic over the showing, and extracts of the former's report are given below.

The method adopted by Mr. Crane was first described and illustrated in the public prints in The Electrical Engineer of Nov. 1, 1893, and is substantially as follows:

It consists primarily in the use of flexible shallow, box-shaped baths, open at one side. Each bath contains a copper electrode and the plating solution, the bath being made water-tight by suitable flexible packing at the edges. Several of these baths are used in the plating of the vessel when in dry dock or upon the stocks, the cleaning of the hull at any one time being only necessary in the places where the baths are to be applied. The baths, which are made flexible in order to follow the curvature of the vessel, are readily supported against its side, on its bottom and along its keel and in other difficult situations, by comparatively simple means, such as tension ropes, screw shores or by magnets attached to the frame of the bath. The vessel is made the negative pole by connection with an electric generator; the plating bath furnishes the positive electrode, and the plating of the entire hull is readily accomplished by shifting the baths from the plated to the unplated sections, and slightly overlapping upon the sections already placed so as to form a continuous coating.



STEAMER ASSISTANCE, SHOWING ELECTROPLATED HULL.

It has been found that a current rate of 7½ amperes per square foot and a difference of potential of 1½ volts are sufficient to deposit a perfectly uniform, smooth and adherent coating to the metallic surface of the vessel. In order that the density of the solution may be kept uniform during the plating process, circulation is effected by permitting the solution to flow into the bottom and out near the top of the bath.

To illustrate the practicability of the method, let us take a ship of ordinary size as an example. A vessel 400 feet long, drawing 20 feet of water, has about 24,000 square feet of surface below the water line. Assuming that one-half of this surface is plated at one time, the current required at 7½ amperes per square foot would aggregate 90,000 amperes, which would be furnished by several dynamos if desired, and the power required to deposit the copper would be equivalent to about 185 h. p. A single de-

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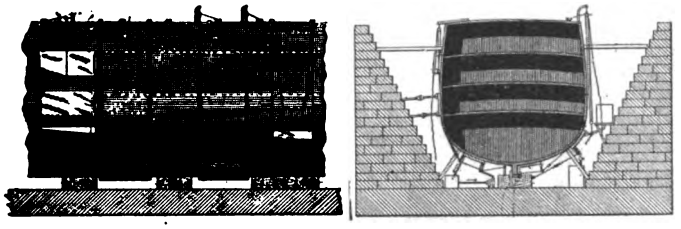
posit of suitable thickness can be made in less than three days, and the whole bottom of the ship can thus be plated in eight or nine days, using about 55,500 pounds of copper, which, at 11 cents per pound, would cost $6,105.

The system which has been developed of late years by the National Ship Plating Co., with offices at 253 Broadway, New York, is fully protected by patents in all the principal countries in the world, and embraces the following features: 1. Special burnishing appliances whereby the entire surface of a vessel can be quickly prepared for the application of the electrolyte. 2. Large sectional and collapsible baths capable of being built up to enclose any desired area of the vessel's surface. 3. A system for producing a uniform distribution of the electrolyte, and a continuous movement of the same over the treated surface. 4. An electric tramway in connection with the vessel, whereby a complete electrical distribution of the circuit is provided, so as to utilize the full potentiality of the current and assure rapid work. 5. Devices for healing any irregularities of the plated surface and polishing the same.

The tests referred to above, and which have, it is said, impressed the Government authorities favorably, were conducted by the well-known electrical engineer, A. A. Knudson, and the electrical chemist, W. J. Comly, both of New York City, and we quote the following from the former's report:

"Referring first to the voltmeter tests. These were made to determine the difference of potential, if any, between the copper coating and the iron hull, so as to ascertain what evidence of galvanic action there was present, between the copper and iron of the vessel that would indicate electrolysis. In noting the readings of these tests, ranging from 1-10 of a volt at the stern to ⅛ towards the bow, sufficient is here shown to cause corrosive action between the two metals, especially if favored by a competent electrolyte, such as salt water; a small fraction of a volt only being required under such conditions to produce this



METHOD OF ELECTROPLATING A SHIP'S HULL.

effect, as has been shown in other similar cases. The iron was positive to the copper in all of the tests that were made.

"One feature of this method of plating has greatly impressed itself upon my mind during the examination of this boat. I refer to the excellent condition of the surface of the copper plating. I am told by those who have been connected with this boat since she was plated four years ago, that her bottom has not been cleaned during that time. With the exception of two places, on and near iron patches where barnacles to a small extent have collected, the entire balance of the bottom is free and clean from any sea growth of barnacles or anything else pertaining to the sea.

"The rubbing of one's hand over the surface immediately after she was out of the water showed the bottom to be covered with a thin film of a slippery substance, which was probably gathered from the salt water.

"In comparing this method of protecting an iron or steel vessel by copper, with that now somewhat in vogue, viz., first sheathing the vessel with wood, and afterwards with copper in sheets, I consider this method by electroplating a substantial improvement for the following reasons:

"1st. The large number of perforations in the hull necessary for bolts to secure the wood sheathing, would weaken it to some extent, while in the copper-plated method, there being no bolt holes necessary, the effect would be to strengthen the hull rather than otherwise.

"2d. The copper sheathing placed over the wood in such close position to the iron or steel would, in my opinion, cause electrolysis as soon as the copper was opened or scraped off, through abrasions, or other causes, admitting salt water to the space between the iron and copper.

"3. In such contingency, which is certain to prevail on most any vessel so treated, the extent of such corrosive effect could not be seen, even after the vessel was docked, since the iron is completely covered by the wooden sheathing, while a copper-plated bottom is entirely exposed, and any evidence of electrolysis can at once be seen and corrected.

"4th. A copper-plated vessel has, therefore, the following advantages over the sheathed and coppered: full strength of hull, smaller bulk, lighter weight, less original cost of applying the copper, less cost of maintaining and repair.

"As a result, therefore, of my investigation, I have the honor to report to you my conclusions: 1st, I have discovered so far nothing about this boat that could be considered as a serious defect or objection to this method of copper plating the bottom of an iron or steel vessel that cannot be easily overcome, and I believe this invention, when intelligently applied and watched with ordinary care, will have a very important future, particularly so if applied to the warships of our navy. The enormous cost of docking ships for the purpose of cleaning bottoms, as well as the great disadvantage when foul, are too well known to need any mention of in this report.

"In conclusion, permit me to suggest that not less than one-sixteenth of an inch of copper plating should be allowed to be placed on the bottom of a vessel, be she large or small. If this is well put on and not abused afterward, I believe a vessel would be practically secure against any corrosive effect due to electrolysis."

It may be of interest to state that experience shows that three months' service in water reduces the speed of a vessel fully 28 per cent. The cruiser "Philadelphia," after a stay of nine months at Honolulu, had her speed reduced from nineteen knots to six knots. It is claimed that as much as $20,000 is yearly expended by various ships in the trans-Atlantic trade as the result of overcoming the added friction caused by fouling. To dock one of the big ships of several well-known lines only twice a year, at $7,500, would bring the total loss per craft up to $35,000 as a yearly penalty for unprotected bottoms. It is a well-known fact that the frictional contact of water against copper is 5½ per cent. less than against iron. A painted surface can never be made as smooth as a burnished copper surface. An iron vessel with a speed of twenty knots per hour, if coated with copper, will have, it is calculated, a speed of twenty-one knots per hour.

The Board of Directors of the company, which has a capital stock of $1,500,000, consists of the following gentlemen: James H. George, president; Richard Grant, treasurer; W. J. Conkling, I. M. Williams, William Paul, Jr., W. W. Jacobus, C. M. Wicker; Charles H. George, secretary.

A New Method of Manufacturing Graphite Articles.

IN general practice, when it has been desired to make an article consisting essentially of graphite, such as motor brushes, carpenters' pencils, crayons, crucibles, etc., it has been the custom to first prepare the graphite and the binding material and then to mold or otherwise form the articles from such materials into the desired shape.

By the present method, the invention of Mr. E. G. Acheson, of Buffalo, the various raw materials are taken in suitable proportions necessary to produce the intended result and are then moulded under pressure into the shape of the article to be made. A greater or less portion of the materials are then converted into graphite, while the moulded shape is retained. For example, amorphous carbon in the form of coke, charcoal, or lampblack, is granulated to the desired degree of fineness and is mixed with some substance capable of combining with carbon, or an oxide capable of being reduced by carbon. An appropriate binding material is then added and the form intended is then given to the mixture. The article is then subjected to a temperature sufficiently high and under such conditions as to cause more or less of the carbon to be converted into graphite. The process may be varied by combining the amorphous carbon in a granulated or powdered form, with a metallic salt, as sulphate of iron, or an oxid of an element, as peroxide of iron, dioxide of silicon, or one of the elements in a state of fine subdivision, as iron filings. These materials may be mixed with the amorphous carbon, either dry or in the form of a solution of the salts or oxids, and when they are mixed thoroughly they are moistened with water, which may have a little sugar, molasses, tar, pitch, or any other suitable binding material in solution, so as to form a paste that can be readily formed into the desired shape of the article

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to be produced. This shape is then placed in an electric furnace and subjected to a temperature and for sufficient time to cause portions of the amorphous carbon contained therein to be converted into graphite. A greater or less percentage of the amorphous carbon can thus be converted into graphite, according to the purposes desired, and in some instances, Mr. Acheson states he has found it advisable to leave a portion of the amorphous carbon unconverted, as it tends to render the article stronger.

While any desired form of electrical furnace suitable for the purpose may be used and the requisite temperature may be produced in any desired way, the following is the most successful method of treating the articles.

The articles are embedded in fine carbon, the bed containing the articles and the surrounding carbon preferably being made into a substantially cylindrical or oblong form, and this is surrounded by a layer of granular amorphous carborundum, sufficiently thick to prevent the rapid radiation of heat. The bed of carbon and its contained articles are arranged in the furnace so that a current of electricity sufficient to raise the temperature to the point necessary for the production of the graphite may be passed through it. In this way are produced articles containing a greater or less proportion of graphite by first mixing the materials and moulding the articles out of the mixture of amorphous carbon and metallic salt or equivalent material and then converting portions of the carbon into graphite, while the article retains its desired shape.

Wagner Method for Deriving Polyphase from Single Phase Currents.

A METHOD of deriving two or more alternating currents differing from one another in phase from a source of electricity supplying alternating currents of single phase has been devised by Mr. Herbert A. Wagner, of St. Louis.

In circuits containing self-induction, the current lags behind the e. m. f. by a certain angle depending upon the relative ohmic and inductive resistances. The current flowing in such a circuit may be considered as due to the resultant of two electromotive forces, one being that which would be sufficient to cause the same flow of current through the ohmic resistance and the other that which would be required to overcome the electromotive force of self-induction or the inductance. These two electromotive forces always differ in phase by an angle of ninety degrees, and with their resultant may be conveniently represented graphically by the three sides of a right-angled triangle.

Slight differences of phase have been heretofore produced between two circuits derived from the same single-phase source by introducing self-induction into one of them and non-inductive resistance into the other. Only slight phase differences are obtainable in this way, however, it being impossible to even approximate or approach a difference as great as ninety degrees, as this would require an infinite electromotive force and an infinite inductive resistance. To produce phase differences in this way which could be effectively applied for any purpose, such as starting or operating alternating current motors, very much higher electromotive forces must be obtained than are required on the working circuits and these electromotive forces then cut down by the necessary ohmic and inductive resistances resulting in a large loss of energy and an unwarrantable increase in the capacity of generators, lines and transformers. By the method devised by Mr. Wagner any number of circuits differing by almost any amount in phase may be derived from two circuits differing slightly in phase, by connecting the required circuits between suitable points in the two given circuits.

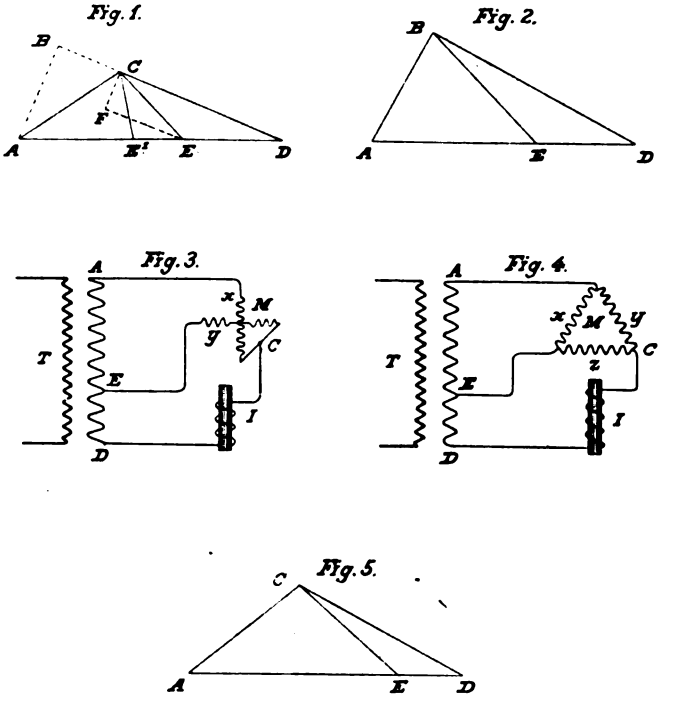
In the accompanying diagrams, Figs. 1, 2 and 5, serve to illustrate graphically the principle of the system, and Figs. 3 and 4 illustrate the manner of operating two and three phase motors, respectively.

In Fig. 1, A D represents in direction and amount the electromotive force of a source of current, such as the secondary of a transformer, C D the electromotive force across the terminals of an inductance coil, forming a derived circuit differing in phase from the electromotive force A D by the angle A D C, and A C the resultant electromotive force across the terminals of a working circuit derived from the source A D and made to differ from it by the angle C A D through the effect of the inductance C D. The greatest angle of phase difference which could be obtained by methods heretofore known may be represented by the angle C A D between the circuits A C and A D. If another circuit is connected from the point C to some point E on A D, an angle A C E is formed with the circuit A C. This angle represents the difference of phase between the derived circuits A C and C E. The point E may be moved in either direction along A D to any other position as, E', and the phase relation of C E, as well as its relative e. m. f. be altered as desired.

If there is no self-induction in the circuit A C, it will assume the position A B at right angles to B D, and the relative phase angles and magnitudes then acquired by the different circuits are shown in Fig. 2. This condition would not be likely to exist, however, in any combination of circuits in which currents differing in phase would be used.

It being assumed in this figure that the working circuits A B and B E have no self-induction, the lines A B and B E truly represent the phase relations between those two working circuits both as to electromotive force and current.

The flow of a comparatively large amount of current in a derived circuit such as C E will cause a slight decrease in the angle C A D by the nearer approach of C to D. This can be



WAGNER SYSTEM OF CONVERTING SINGLE PHASE TO POLYPHASE CURRENTS.

corrected by increasing the inductance C D, or the phase relations between A C and C E can be retained by moving the point of connection E.

Fig. 3 shows the application of the principle to the operation of a two-phase motor. T is a transformer with secondary coil A D. M is a motor with its two circuits or sets of coils x and y joined at C and with their other terminals connected one to A and the other to E, and I an inductance coil connected between C and D. The designating letters being the same as in Fig. 1, the phase angles can be readily traced.

In Fig. 4, M represents a three-phase motor with sets of coils x, y and z. The coils y and z are joined at C, their other ends being connected to the transformer at A and E, respectively. The coil x is connected between the transformer terminals A and E, and the junction C is connected to the other transformer terminal D through the inductance coil I.

Fig. 5 shows graphically the phase angles obtained in the arrangement illustrated in Fig. 4.

AUTO-TRUCK. A test was made of a compressed air motor last week by Mr. Richard Croker at the American Power Co.'s works. It is reported successful. The new Auto-Truck Company will bid for the contract to transfer bonded goods in this city between ocean ships and warehouses. It will also endeavor to bring about the adoption of compressed air motors on the city fire engines. The bonded goods contract is worth about $200,000 a year.

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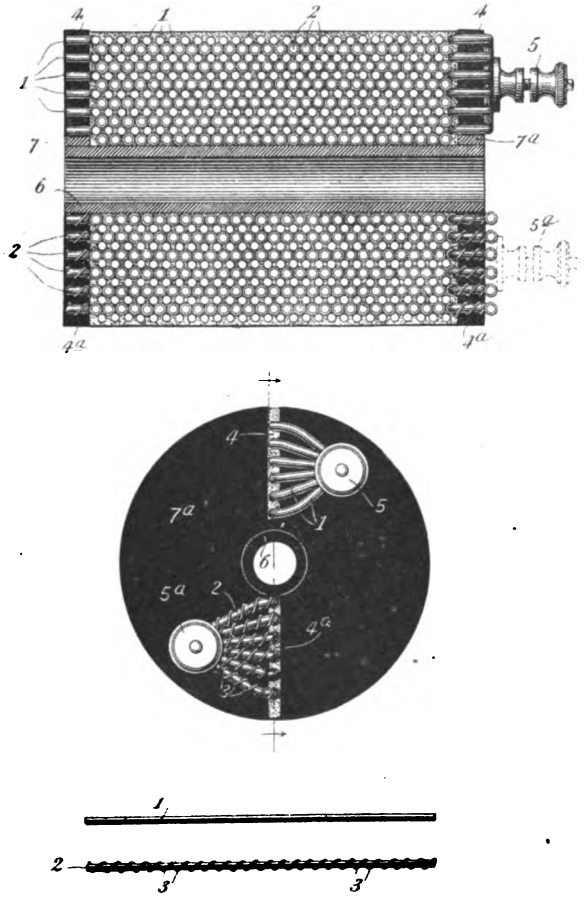
A New Bradley Electric Condenser.

IN constructing this condenser two conducting wires are wound upon a bobbin, preferably arranged in alternate layers, one of the wires being wrapped with thread having a comparatively low specific inductive capacity, the several convolutions of which are separated from one another so as to leave open spaces between them and the other wire being bare. The wires may be coated before winding by the material which is to constitute the dielectric of the condenser, stearate of lead, and afterward immersed in a hot bath of the same, so as to permit the fluid material to penetrate all the pores or inter-spaces between the condenser surfaces. The ends of the several layers are taken out upon the heads of the bobbin, the several ends of the spirally-wound conductors being connected to a common terminal and the ends of the bare conductors being connected with



FIGS. 1, 2 AND 3.—THE BRADLEY CONDENSER.

an independent terminal. The two terminals are adapted for connection with the two separate wires of an electric circuit.

On the same general principle it may be formed of a plurality of wires wound in close relation, so as to lie adjacent to one another, one of the wires being wound with an open spiral of insulating material to form a spacing medium which will prevent mechanical contact of the two metallic surfaces with one another.

In the accompanying drawings, Fig. 1 is a sectional view, part in elevation, of a condenser embodying these features. Fig. 2 is an end view of the same, and Fig. 3 is a detail view of a portion of two wires used to constitute the condensing surface. This condenser is the invention of Mr. C. S. Bradley, of Avon, N. Y. In the cuts, like numbers refer to like parts.

THE TRADESMAN, of Chattanooga, Tenn., a representative industrial organ for the whole South, has just issued a splendid New Year number devoted to the trade, commerce, railroads, agriculture and general development of that section. It is well done and constitutes a perfect mine of information.

SYRACUSE, N. Y. It is proposed to instal an electric fountain on Hanover Square, operated with current furnished by the Syracuse Electric Light and Power Co.

Electrically Operated 150-Ton Jib Crane at Newport News Shipyard.[1]

BY WALTER A. POST.

TOGETHER with the demands of the day for greater capacity, greater power and greater speed, as essential characteristics of the modern ship, there comes the dependent feature of greater weight, and, to the shipbuilder, the problem attendant upon this feature, namely, that of providing for the economical handling of these weights.

The plant of the Newport News Shipbuilding and Dry Dock Co., although well provided from its origin with appliances for handling material, was found in its later developments to be in need of apparatus more powerful and more convenient than the 100-ton sheer legs which, to that time, had been used for handling the heavier weights installed on board ships during the fitting-out period.

The growing need of such apparatus had been for some time forcing itself upon the attention of the company, but it was only in the spring of 1896 that it was finally determined to undertake its provision, and steps were taken to ascertain from the experience and opinions of experts, both in this country and abroad, what general type of machine would most satisfactorily fill the particular requirements of the Newport News plant.

The fundamental requirements, briefly stated, were: Capacity to lift and place on board the heaviest single weight liable to be incurred in the probable development of modern ships; a field of operation, as large as practicable, in which these weights could be handled, and absolute precision within this field; a location accessible by the ordinary means of transportation from all parts of the yard; and, finally, that greatest factor defined in all projects by the broadest use of the word economy.

Careful consideration of these requirements lead to the adoption of a 150-ton revolving derrick, electrically operated and controlled, mounted on a steel tower supported in turn by pile foundations. The structure was located on one side of a pier 700 feet long, forming one side of a slip, in which a number of ships may be moored at one time and readily brought within the field of the derrick's operation. Two standard gauge tracks over entire length of pier afford means of transportation from any part of the yard, and also direct connection to the main lines of the Chesapeake & Ohio R. R. system. The floor of the pier, 185 feet in width, furnishes ample room for the temporary reception of heavy pieces, castings, armor, etc., and permits, in addition, the assembling of much work within direct reach of the derrick, thus allowing assembled parts to be placed on board as a single member, relieving the tendency to overcrowd floor space in the shops and effect a saving in cost over work as assembled on board ship.

The final design of the derrick was taken up about March 1, 1897, and in July, 1898, sixteen months later, weights were being placed on board the battleships in course of construction at the yard.

Aside from the steel work in the tower, it was designed, constructed and erected by the Newport News Shipbuilding and Dry Dock Co., under the direction of Sommers N. Smith, at that time general superintendent of the works. The design of the derrick itself, including steel tower, jib, hoists and machinery in general, was prepared by the steam engineering department under C. F. Bailey, the direct working out of the plans and details being assigned to R. L. Lovell of the same department. The successful completion and high efficiency of the whole machine attested both the care and skill of the designers and the workmanship of the yard force. The steel tower was furnished and erected by the Berlin Iron Bridge Co., of East Berlin, Conn., while the foundations were designed and constructed under the direction of the author. The illustration is from "Marine Engineering."

A brief statement as to size, capacity, range of operation, etc., may be of interest before proceeding to the description of particular details.

[1] Read at the Sixth General Meeting of the Society of Naval Architects and Marine Engineers.—Abstract.

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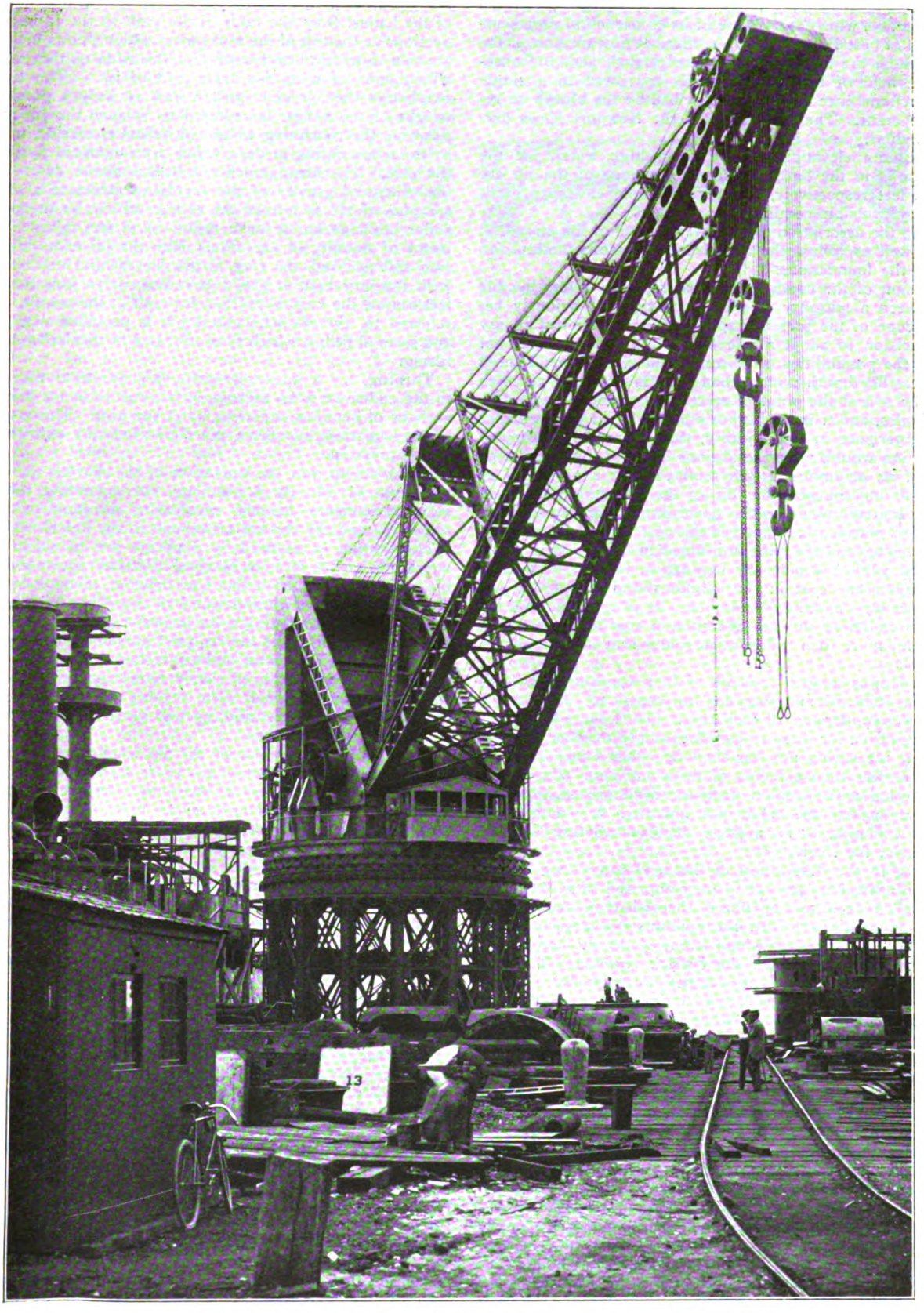
The derrick jib is capable of having its outer end raised or lowered, thus giving to the hoisting blocks, which depend vertically from this end, a movement not only of rotation about the centre of the derrick, but also of translation in or out from this centre. With the outer end of the jib in its lowest position the hoisting blocks will, on rotation of the derrick, describe the circumference of a circle 207 feet diameter; with the jib in its highest position these blocks, on rotation, describe the circumference of another concentric circle 88 feet in diameter, thus permitting the derrick to operate on weights lying anywhere within the circle ring whose maximum and minimum diameters are 207 feet and 88 feet, respectively. The maximum load of 150 tons can be handled only within a ring whose maximum and minimum diameters are 147 feet and 88 feet, respectively, but weights



ELECTRIC CRANE FOR SHIPBUILDING WORK—NEWPORT NEWS, VA.

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up to 70 tons may be handled throughout the entire field of operation. This feature of varying the radii at which the hoisting blocks can operate, constitutes a most important difference between the derrick under discussion and the 130-ton steam crane erected in 1893 on Finnieston Quay, Glasgow. In the Finnieston crane, which at the time of its construction represented the ideas of best English practice, there is no variation in the radius at which the hoisting blocks are carried, and, in consequence, the field of operation becomes narrowed to a single line, the circumference of a circle described by the blocks on revolving the crane. The advantages of the Newport News derrick are obvious.

The maximum elevations, above mean high water, for the hoisting hooks in the high and lower positions of the jib are 118 and 69 feet respectively, this giving ample clearance vertically for any probable conditions.

Taking up the description of the several parts of the structure, it may be well to follow the actual order of construction and begin with the foundations.

A discussion of the conditions which serve to determine the choice between a masonry or pile foundation is obviously beyond the scope of the present paper, and it is sufficient to say that the decision to adopt a pile foundation was reached, not alone after the possibilities of masonry, but also of metal tubes and cylinders filled with cement, had been investigated at much length. The soil at the point of erection is eminently suited to the use of piles, and it is the author's belief, based on a number of years' experience in that locality, that a properly creosoted pile foundation would, under conditions imposed, have about 90 per cent. of its original strength retained after a period of 25 years. Assuming the probable life of the foundation to be 25 years, and recurring again to the governing factor of economy, we may, with pertinence, state that the cost of such foundation was about $8,000, and the time consumed in construction about two months; while the masonry foundation for the Finnieston Quay 130-ton crane cost in the neighborhood of $45,000, and required seventeen months to complete. It is apparent that the interest accumulations on the difference in cost for a period of 25 years is far more than sufficient to renew foundations and reerect derrick.

The foundations adopted consist of four concentric rows of piles, driven vertically and spaced 3 feet centre to centre measured on the circumference of each ring. One hundred and fifty piles were required for these rings, all carefully selected straight, round sticks, measuring not less than 14 inches 6 feet from the butt, and not less than 9 inches at the small end. They were carefully treated with London ordinary dead oil, of approved quality, 16 pounds to the cubic foot, and then driven, under a 5,000-pound hammer, to an average depth of 28 feet into the hard bottom of the river.

Proceeding to the description of the steel tower—we have a structure cylindrical in general form, comprised of sixteen columns securely braced, and anchored, through their shoe plates, to the pile foundations below, the columns being surmounted by a series of box-girders to which is bolted the cast-steel track carrying the rollers on which the derrick revolves. The sixteen columns are equally spaced over the circumference of a circle 36 feet diameter and set square to radial lines through their centres. They are built up of two 15-inch channels, 70 pounds to the foot, well latticed on the sides, with batten plates, top, bottom and midway their height, at which point horizontal and diagonal braces connect.

We have now reached the revolving structure or derrick proper, which may be, for convenience of description, divided into two members; the housing, a heavily framed structure containing the generating and controlling machinery, operating platform, and counterweight or ballast; to this is secured the second member, namely, the jib, which, carried by the housing and controlled by the power therein, carries in turn the sheaves and blocks through which all the hoisting power must be finally applied.

Recurring to the housing, a brief description will suffice to indicate its general character and note interesting features.

Resting on the conical rollers is a circular girder. On this is carried the heavy cross-girders which furnish supports and foundations for the generating motors, heavy gearing, drums and other parts of machinery. In a central bearing is the 16-inch pin previously mentioned; at one end of the cross-girders is secured, by a 9-inch pin connection, the lower end of the jib, while at the opposite end of the girders rises the ballast tank containing 410 tons of pig iron ballast. The ballast tank is built up of heavy floor girders, resting on and running at right angles to the cross-girders above mentioned. From the extremities of these floor girders rise the vertical ends of the tank, each end being a hollow box section and serving to transmit the weight of the ballast from the floor of the tank to the 10-inch pin connections at the top of the tank, from which points inclined struts are run downward and across to the ends of the cross-girders which connect with the lower end of jib. The ballast tank overhangs the circular girder, and as only a portion of the weight of the ballast is required to balance the jib in its high position, the remaining weight of ballast is carried, in that case, by the overhanging girders, which are reinforced by brackets on the side. The arrangement of ballast above described brings the centre of gravity of the revolving structure always within a radius of 7½ feet from the centre, which, as the path of the roller bearings has a mean radius of 18 feet, gives a minimum factor of stability of 2.4. Thus, with the jib in its highest position and no load, the c. g. is 7½ feet behind the centre, while with 150 tons load at 73½ feet radius, or 70 tons load at 103½ feet radius, the c. g. is 7½ feet forward of the centre. As before referred to, the 16-inch central pin is provided with a top nut and secured below, which thus affords a further safeguard against tilting.

Turning, for a moment, to the jib, attention may be called to the endeavor to so arrange sheaves as to bring the minimum amount of bending and wear upon the pins. The member as a whole is a triangular truss, pin connected and with its long side in compression.

In taking up now the operation of the derrick we will divide our remarks into three headings, corresponding to the three main movements, namely, revolution, elevation or depression of the jib, and the vertical movement of the hoists.

The derrick is revolved by duplicate sets of machinery, each consisting of one No. 800 General Electric railway motor, capable of developing 20 h. p., and driving, through means of a double-threaded worm and wheel of the Albro-Hindley pattern, a pinion which, engaging a horizontal circular rack on the outside of the tower, gives the required movement of rotation. The motors are series wound and controlled from a series parallel controller, giving high efficiency under starting conditions as well as at normal speed. The turning motion is very smooth and perfectly noiseless, and, as will be seen from the tests, requires very little power.

The racking movement of the jib is effected as follows: At the inner and upper apex of the jib is a 10-inch steel pin carrying twenty-two cast-steel sheaves, each sheave of 5 feet pitch diameter. At the upper apex of the housing is another 10-inch steel pin carrying twenty-four similar sheaves. Leading over these two sets of sheaves, and sustaining the weight of the jib and load, are two 1¼-inch steel wire ropes, each rope being wound on alternate sheaves, and each end of each rope brought down to separate drums, located below in the housing, this arrangement ensuring freedom from side twisting on the sheaves and also requiring each rope to take its share of the weight. The four drums, on which these ropes are wound, are arranged in pairs, each one of a pair taking opposite ends of the same rope and each pair driven by a No. 2000 General Electric series motor of 100 h. p., the power from the motor being transmitted to each drum through a separate train of gears. The drums are of cast-iron, 5 feet pitch diameter, carried by 7-inch steel shafts. Each rope, having twenty-two parts, is strong enough to sustain and operate the jib when under maximum load, thus guarding against accident and enabling either motor to be disconnected, and the rope, which it controls, to be removed for repairs or renewal. The motors are series wound, which ensures each taking its proper share of the load.

Passing finally to the hoist, we have two main hoists, each of 75 tons capacity, and one 20-ton whip for lighter loads. The main hoists are each of 12 parts, 1¼-inch steel wire rope, leading over six sheaves, 5 feet pitch diameter, carried on a 10-inch steel pin at the outer end of the jib. The lead from these sheaves to the operating drum is carried down the jib on wooden roller runners. These drums, one for each hoist, are of cast-iron, 8½ feet pitch diameter, carried on 7-inch steel shafts, and each driven through a train of gears, by a No. 2000 General Electric 100 h. p. motor, series wound. These hoists may be coupled together and operated as one hoist of 150 tons capacity. The 20-ton whip is of three parts, 1¼-inch steel wire rope, carrying a single block and leading over two sheaves, carried, as are

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those for the main hoist, at the outer end of jib. The lead from these sheaves passes down the jib, over a single guide sheave, to a cast-iron drum, 8½ feet pitch diameter, driven through a train of gears by a No. 2000 General Electric 100 h. p. motor, series wound.

It will be noticed that electricity is used to generate the power required for all the movements of the derrick. The question involved in the choice as to the form of energy to be employed in such a machine cannot be fully discussed here, but the convenience of operation, ease of movement and general efficiency of the present derrick attest the successful use of electricity in this case. Current is transmitted, over heavy insulated copper wire, to fixed brushes, attached at the centre and near the top of the steel tower. These brushes are arranged to bear against circular contact rings insulated from, but carried by, the centre casting to which the roller rods are secured. Near the top of this casting are two more contact rings which transmit the current to a pair of brushes, fixed to the revolving part of the derrick, from which the current is delivered over heavy insulated copper wire to the several motors. The current is delivered to the motors, under normal conditions, at a pressure of 220 volts.

Before concluding, it may be interesting to note a few particular features, and to give the result of such tests as opportunity has permitted up to the present time.

The brakes are a feature of considerable interest. These were required to occupy little space, be powerful and certain in their action, and to be automatic. This was accomplished by extending the ordinary band brake so that it wound four and one-half times around a brake cylinder carried on the shaft to which is keyed the pinion that meshes into the gear of the operating drum. This brings the brake in as direct connection with the load as possible and guards against accidents of the machinery. The brake cylinders are of cast-iron, 30 inches in diameter, with the wearing surface chilled. The band is of wrought iron 1 inch thick, 5 inches wide at one end, and tapering to 1¼ inches at the other. The broad end is firmly anchored, while the narrow end is secured to a lever carrying a weight of 200 pounds. When lowering the jib or the hoisting blocks, the direction of rotation for the brake cylinders is toward the small end of the band, so that the friction, produced by the weight, between the cylinder and band, causes the band to wind tight on the cylinder and stop rotation. In hoisting, the brake releases itself, the friction lifting the weight and uncoiling the band, while any tendency to rotate in the opposite direction causes the weight to fall and the band to tighten. To release the brake it is only necessary to lift the weight, which is done by means of a wire connecting with a lever in the operating house, the lever being always within reach of the operator and the brakes always in operation except as released by continuous pull on the lever.

The operating station is directly underneath the lower end of the jib, overlooking directly the weights to be handled, and encased with glass front as a protection against the weather. The controllers for the several motors are within easy reach of a single operator, who is thus given convenient and absolute control over the varied movements of the derrick. The ropes for the hoist and racking movement are all of plough steel wire, 1¼ inch diameter, of six strands of thirty-seven wires each, with hemp centre and very flexible. Each rope has a breaking strength of 100,000 pounds. The gears throughout, except the worms and those supplied with the motors, are of cast steel, with cast teeth, the pinions being full shrouded. These gears work very smoothly and show a high efficiency.

The difference in power required for the two main hoists is explained by the fact that all gears, except the pair on motors, have cast teeth, and, consequently, variable friction. All tests were made soon after the completion of the derrick, and still better results may be anticipated when opportunity has been given for the gears to wear smooth.

The jib has been both raised and lowered with loads up to 66 tons, but, as this was done only in regular course of work, no data was taken. In hoisting, the required power decreases as the moment of the jib decreases. In lowering, power is required to start the machinery, after which the weight of the jib will keep it in motion.

The variation in speed and power required was probably due to influence of the wind, as the observations were taken on different days, with different velocities of the wind. Two of the tests, taken as near as possible, show no difference in result, although the position of the centre of gravity, varied considerably.

In concluding this paper it may be said that the most difficult problem encountered in the design of the derrick, was that of providing a safe and efficient way of operating the jib, and, in so far as the author knows, the method adopted is, considering the large forces involved, something of a novelty. The results attained and the efficiency of the mechanism would indicate that the problem had been well solved, and that the idea here carried out might, with advantage, be extended by other designers to future problems.

Electricity and the Increasing Importance of Inorganic Chemistry.[1]

BY DR. V. HOFF.

LET us look more closely at the condition of things at the present time. The discovery of thiophene by Victor Meyer, and Fischer's work on the sugars, are referred to. Notwithstanding the relatively small number of workers in inorganic chemistry in recent years, very brilliant results have been obtained. Those mentioned are: The discovery of the volatile compounds of iron and nickel with carbon monoxide, by Mond; of triazoic acid by Curtius; of six new elements by Ramsay; the artificial preparation of the diamond by Moissan; the carbides, selenides and borides, prepared by the same investigator.

Let stress be laid upon it that this experimental result is, in part, dependent upon the use of electricity, which is applicable chiefly to inorganic compounds. Let us examine more closely the details of this application; what electricity has already done, on the one hand as a source of higher temperatures, on the other as a means of effecting separations.

Electricity as a source of heat is of fundamental importance. The temperatures which can be reached by combustion processes are limited. By this means we cannot obtain temperatures very much above 3,000°. In the electric furnace temperatures as high as about 4,000° can be reached.

The electric furnace in the hands of Moissan, has opened up a new way of preparing valuable and important substances. It is evident that this applies chiefly to inorganic chemistry. Higher temperatures do not form, but break down the molecular complexes which constitute the problems of organic chemistry. Our own existence, which depends chiefly on the interaction of such complex molecules, cannot be continued up to 50°. The compounds of the hydrocarbons which were obtained in the electric furnace, as carborundum and calcium carbide, have no value for the synthetical processes of organic chemistry.

If we turn to electricity as a means of separation, it is self-evident that it can be only indirectly applied to organic chemistry whose chief aim is synthesis. Most of the organic compounds do not belong to the electrolytes, which can be broken down by electrolysis. Most of the metals can, however, be separated by the current, in a form suitable for weighing, by using the proper intensity of current, and can be separated from one another by using a suitable electromotive force. The halogens have recently been separated in the same manner. A step is thus taken for inorganic analysis, which is comparable to the work of Liebig on the analysis of organic substances.

What has been accomplished by the use of electricity in separating the metals on a large scale, can be seen from the following data: In 1897 one-third of the entire copper produced (137,000,000 kilograms) was obtained electrolytically. The larger part of the gold and silver were obtained in the same way. Sodium is produced entirely by electrolysis (260,000 kilograms in 1897), and the increase in the aluminum produced, from 9,500 kilograms in 1888 to 321,000 kilograms in 1894, is to be referred to the same cause. This aluminum can now be used for the preparation of other metals which were difficult to obtain. At the last meeting of the Electro Chemical Society in Leipsic we saw almost chemically pure chromium prepared by suitably igniting a mixture of aluminum and chromium oxide. In the same manner, manganese, titanium, tungsten, vanadium, cerium, etc., were

[1] Abstract of Lecture before the Society of German Scientists and Physicians.

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formed. This opens up a field in the metal alloys, which will, perhaps, be of technical importance.

We thus see inorganic chemistry teeming with remarkable discoveries, enriched by a new method of preparing substances, and simplified analytically. The ground is also unusually fruitful for applying and developing the fundamental generalizations which have been reached in chemistry in the last few years.

When, in 1843, Kopp declared that a new stage of development in chemistry would follow the period of quantitative investigation, first by union with another branch of science, he saw in advance what is now being effected in the union of chemistry and physics, which is being accomplished by the new physical chemistry. Let us call attention to the importance of applying the two fundamental principles of thermodynamics to chemistry, and how far consequences derived from these principles can be subjected to experiment, and what the result is.

The problems solved in this way, belong to the most important of our science, but receive a solution which has so little in common with our atomic and structural conceptions that they often do not appeal to chemists trained in the latter school. By this means problems will be solved, also biological problems, which lie out of the scope of the configuration method. By applying thermodynamics to chemistry it is chiefly inorganic chemistry which is advanced.

We must mention first the problem of affinity. Thermodynamics does not refer affinity to the reciprocal action of atoms, but measures affinity by the maximum work which the reaction can perform. Let us consider reactions which take place with increase in volume, say the union of copper and calcium acetates to form the double salt. If this reaction takes place in a closed vessel the walls are broken. On the other hand, the reaction can be hindered by bringing a counter pressure to bear on the salts, say by a piston and cylinder; and Spring has actually shown that the double salt can be broken down by subjecting it to several thousand atmospheres of pressure. This counter pressure, which just prevents the reaction is very closely connected with affinity regarded as force, and affinity is determined as work by the mechanical work which is done by the reaction against the maximum pressure.

The reaction may complete its maximum work in other ways, as in an electric battery, and it can then be measured from the electromotive force of the battery.

We arrive, in this way, at a generalization of great importance: A transformation will, then, only take place of itself in case it is in a position to do a positive amount of work. If the amount of work done is negative the transformation can only take place of itself in the opposite sense. If the work done is zero it can take place in neither sense.

This work and the possibility of reaction depending upon it, can be calculated in any given case, provided the work is ascertained, once for all, which is done when each of the substances in question is formed from the elements. This work can be expressed, e. g., in calories. This "work of formation," by simple addition and subtraction, leads to the "work of transformation," the sign of which conditions the possibility of the transformation. This programme has been carried out, to a certain extent for the mercury compounds, by Nernst and Bugasky. It should be mentioned that from this principle it was foreseen that mercurous chloride must be decomposed by potassium hydroxide, although the transformation takes place with heat absorption.

We have obtained, also, a generalization for reactions which only partly complete themselves, on account of the introduction of the opposite reaction, which leads to a condition of so-called chemical equilibrium, as in the combination of iodine and hydrogen, and in etherification. It is essential that, in such cases, changes in concentration should be produced during the reaction, and on account of the reaction. These decrease the work of transformation, finally bringing it to zero, whence the reaction velocity gradually decreases and finally, also, becomes zero. In the union of iodine and hydrogen the increasing concentration of the hydriodic acid formed, introduces a gradually increasing opposing force, which finally brings the reaction to rest.

There is thus obtained a further principle, applicable in many directions. The point at which a reaction comes to rest can be calculated from the work of transformation. This was strikingly confirmed very recently by Bredig and Knüpffer, on the basis of measurements of electromotive force; it was accurately determined when the double decomposition of thallic chloride and potassium sulphocyanate came to rest.

But also the change in work of transformation through changes in temperature, pressure and mass can be calculated from thermodynamics, and also the consequent shifting of the point of equilibrium. Quantitatively expressed, this shifting always takes place in the sense that cooling favors whatever is formed with evolution of heat, until finally, at absolute zero, all reactions are completely displaced in this sense. Then the course of the reaction would be conditioned by the "heat of transformation," which at zero would be equal to the work of transformation.

In studying equilibria from this standpoint, not only the existence of every substance, but also the conditions of existence, are determined. And it may be added, not only the conditions of existence of individual substances are determined, but also all the compounds which it is possible to obtain from given materials, say water and salt. The reinvestigation of magnesium chloride from this standpoint gave not less than six different hydrates.

This method of investigation closely resembles the complete survey of a region where formerly only individual cities and villages were recorded. In the not very distant future inorganic chemistry may do for geology what it has already done for mineralogy in the preparation of individual minerals.

The views here expressed will be of chief service in inorganic fields, since two obstacles are in the way of applying them to organic chemistry: First, the great possibility of compound formation. A single pair of substances, as carbon and hydrogen, gives rise to an unlimited series of compounds. Second, the very sluggish manner in which organic transformations take place, causes reactions which are possible, to proceed very slowly, or not to take place at all. Thermodynamics stands here, in its application, as before a very complex engine which is rusted until it is useless.

But the application of thermodynamics to chemistry has been made in another direction, and here the physical chemistry of today has found its most fruitful field. The possibility of determining the molecular weight of dissolved substances is given by the so-called osmotic methods. A very great need of inorganic chemistry would thus be met. The molecular weights of organic compounds, which are often volatile, were generally known by determinations of vapor-density. The inorganic compounds investigated in this respect were, on the other hand, exceptions. The work of a few years has sufficed to fill up these omissions.

We arrive, then, at our last point, a consequence of these osmotic methods, that electrolytes—salts, acids and bases—are broken down in aqueous solution in a peculiar manner. The only explanation which meets the case is that of Arrhenius, according to which a dilute solution of, say hydrochloric acid, would contain instead of molecules of acid, negatively and positively charged atoms of chlorine and hydrogen.

It is still impossible to pass final judgment on this fundamental change of our conceptions, yet it is a fact that the most widely different properties of solutions agree qualitatively with the new conceptions. Quantitatively, the result calculated agrees very nearly with that found, but, thus far, the agreement is not always perfectly satisfactory. It is of chief importance for our purpose that a new impulse was thus given to the study of solutions of salts, acids and bases, i. e., chiefly to inorganic compounds.

PERSONAL

Mr. J. J. Carty Before the University of Minnesota.

Mr. J. J. Carty, the well known chief engineer of the New York Telephone Company, delivered an interesting lecture on Telephone Disturbances before the College of Engineering of the University of Minnesota on Tuesday, January 24. The sources of disturbances upon telephone lines were discussed in an able and intensely interesting manner with the help of numerous diagrams.

The next lecture of the course will be by Mr. Truman Hibbard, on transmission of power from waterfalls.

INDEPENDENT TELEPHONE MEN had a meeting in Pittsburg last week, with Mr. J. E. Keelyn to the fore.

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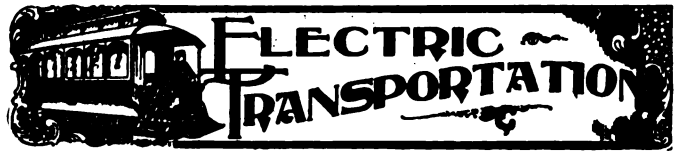
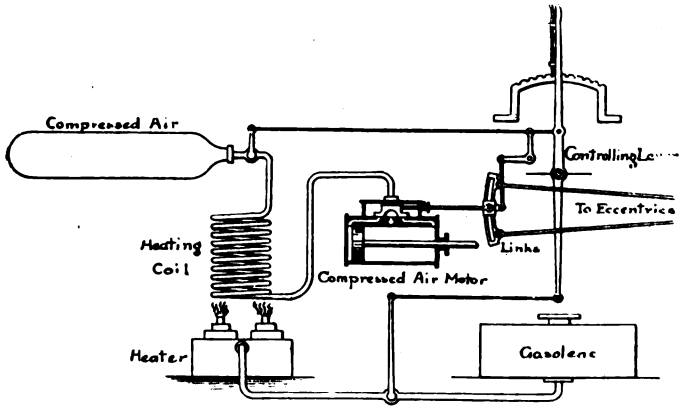


Compressed Air Auto-Trucks in New York City.

A GREAT deal of interest continues to be naturally taken in the development of the newer compressed air enterprises recently exploited in this city. Altogether aside from the active stock speculation that has been engendered interesting the lay public, is the method of operation which is not generally understood. We furnish herewith a neat little diagram which shows the broad plan of operation, and from which the reader can

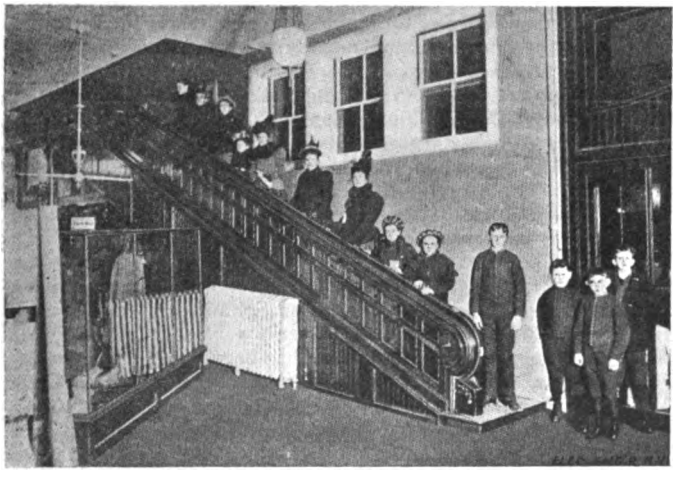


MECHANISM OF COMPRESSED AIR TRUCK.

form his own conclusions as to how far such apparatus with "reheaters" as shown, and employing reciprocating motion is likely to come into vogue on the streets of a city. Up to the present time, fuller details have not been given out as to the exact mechanism necessary for each class of service, but it is inferred that it will be heavy and therefore intended for application, as the name "Autotruck" implies, more particularly to heavy traffic, such as is now handled by drays.

Reno Inclined Elevator in a Providence Store.

ONE of the most progressive and successful business houses in Providence, R. I., namely, that of Shepard & Co., have again shown their foresight and business sagacity by recognizing the many advantages possessed by the Reno inclined elevator, and installing one of these machines in their mammoth



RENO INCLINED ELECTRIC STAIRWAY, LEFT-HANDED RAILING, PROVIDENCE, R. I.

store. The only difference between the elevator installed here and the one at Bloomingdale's department store in New York, described in The Electrical Engineer July 7, 1898, and the duplex one at Loeser & Co.'s store in Brooklyn, described in The Electrical Engineer Jan. 12, 1899, is that the moving hand rail is to the left of the up-going passenger. This was made necessary by the location, as seen in the illustration, and experience with the machine, which has now carried several hundred thousand passengers, has shown that it makes no material difference whether the moving hand rail is to the left or the right of the passenger.

The elevator is operated by a 5 h. p. C. & C. iron-clad motor, running at a speed of 500 revolutions per minute. It is located on the second floor adjacent to the side of the elevator, and is enclosed in an ornamental oak-paneled case, 24 inches square. This makes the motor very accessible for repairs or adjustments, and does not necessitate the floor to be cut. The 6-inch pulley on the motor shaft drives a 30-inch pulley on a short countershaft by means of a 6-inch endless leather belt. This pulley drives the elevator by means of a 4-inch cast steel pinion and a 30-inch spur gear wheel on the main elevator shaft. This makes the machine absolutely noiseless, and only 10 per cent. of the power of the motor is lost in reducing the speed in the proportion of 40 to 1.

All the frame work and moving parts of the elevator are encased in polished oak paneling, and present a very attractive appearance. It will be seen that in addition to its numerous advantages such as safety, economy of space, capacity and doing away with attendants, two such elevators located at opposite sides of the store, the one carrying passengers up, the other bringing them down, would cause a thorough circulation throughout the second story, and would make this floor almost as valuable as the ground floor. And all these advantages at the small operating cost of one dollar per day speaks volumes for the future of these electrically driven stairways.

LIGHTING BY ACETYLENE. By W. E. Gibbs, M. E. New York: D. Van Nostrand Co., 1899. Second edition. Cloth, 12mo, 161 pp.; 64 illus. Price, $1.50.

The demand for this interesting and popularly written little book has been so large that it has already run into a second edition, which is now brought out with various changes, additions, etc. Calcium carbide and the use of acetylene gas are the subjects of much inquiry among all classes of people, especially makers of domestic gas, electric lighting companies, chemists, students and those who are now supplying small plants for isolated work. We have been told that the farmers throughout the country "by the million" are giving up oil and candles and adopting acetylene gas, and that the market for such apparatus among them exceeds that of the ancient "lightning rod craze;" and there seems no good reason why this should not be a material boon to them, whatever may be the effect on the market for kerosene. This neat little volume discusses many practical and technical phases of the subject in simple, direct language, and is recommended to all who, without much leisure, wish to be intelligently informed about the matter. Later editions will no doubt be able to give us actual data from working plants as to real cost in operation and supply, for which information just now there is a genuine hunger. That a vast new market has been created for this product of the electric furnace is without question.

Warning Against Acetylene.

Edward Atkinson, president of the Boston Manufacturers' Mutual Fire Company, in view of recent renewed efforts to introduce calcium carbide and acetylene gas into commercial and manufacturing establishments, has published a cautionary circular in which he says: "The purpose of this caution is to call upon each and all of our members not to make use either of calcium or acetylene gas without full advisement and consultation at the time the proposed application is to be made. It may happen that the use of these materials may be made safe. At present they are not deemed so. Therefore, the introduction of either, without the consent of the underwriters, would make an alteration in the condition of the risk not contemplated in the original contract. It is therefore suggested that no new method of lighting shall be permitted, even for experiment, without consultation."

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The Chance of the Electrical and the Civil Engineer.

ONE would hardly look for "competition" among educational institutions in their efforts to secure students, and much less would one expect to find any among them attempting to "run down" its sister institutions—to use a business phrase. Yet in no other light can we regard a circular letter issued recently by an institution which has long borne a high reputation, and deservedly so, if one may judge by the work of its graduates. This institution makes a specialty of instruction in civil engineering, but has now gone out of its way to call the attention of prospective students to "the very restricted field for the electrical engineer and to the error committed by those who advise young men to take a so-called course in 'electrical engineering,' and thus not only dwarf their general professional usefulness, but by the evils of early specialization tend to prevent them from becoming eminent even as electrical experts"—and more of like import.

For a bit of specious argument, the extract quoted above is as good as we have encountered in many a long day. We have yet to learn of any reputable college which gives a course in electrical engineering, that does not give its students a complete course in mechanical and general engineering as a basis for the electrical work. Indeed in most of these institutions the student, during two years of the four years' course, scarcely hears the word "electricity" mentioned. As to the evils of "early specialization," here also a lamentable distortion of the meaning of that term is apparent. We know of no electrical engineering college that turns out "specialists" in any branch of applied electricity; but all of them certainly do graduate men who are equipped to take up and specialize in any particular electrical work which may fall to their lot or may take their fancy. What more, we would ask, can any institution of learning provide its graduates with, than the foundations upon which each must build for himself according to his tastes and abilities?

What percentage of the graduates of the institution which issues the circular above quoted have made great names for themselves as railroad builders, bridge engineers, etc.? Probably comparatively few; and this is but natural. But we venture to say that the large majority of its graduates have found lucrative employment in their chosen fields. And this is exactly the case in the electrical engineering branches. We know of no electrical college which holds out to its graduates the promise of high positions; but we do know that the best engineering positions in all the electrical manufacturing, electric light and railroad industries are to-day held by graduates of electrical engineering colleges; and their number is constantly increasing. But when one stops to consider the chances of the graduate electrical engineer in the growing arts of electro-chemistry, electro-metallurgy, electric smelting, electric heating, not to forget electric vehicles, etc., as compared with those of the graduate civil engineer, the choice of a course of study for a youth desiring to enter any one of the electrical fields can hardly be open to question. That the electrical engineer may have to, and frequently does, call upon the civil engineer, the mechanical engineer, and the architect, to assist him in his work, is admitted; but one might as well expect the bridge engineer to design a bridge structure, and at the same time to be competent to produce the steel of which the structure is to be built—a task for which the metallurgical engineer alone is fitted, and which is usually left to him. We heartily endorse the policy of the institution whose circular is before us, in giving its students in civil engineering a good foundation in electrical principles, but we must protest against the stand some one has apparently taken for it and the advice it presumes to give to guide those who intend to make electricity their life work.

Steam Engine Efficiency.

IT is a matter of general comment among foreigners who come to study industrial progress in America that we are wasteful of our material, and that we fail to take advantage of the refinements which would be forced upon us were our natural resources less bountiful than they are. This well-meant criticism, is without doubt, deserved, and has been particularly true as applied to the methods of steam generation generally in vogue in the United States, and, we may add, even more true as regards its generation for the purposes of electric lighting and power work. When arc lamps were rented at from ten to twenty dollars a week, a few tons of coal more or less per day made little difference in the balance sheet, but with price ranging between 25 and 35 cents per night economies must be observed to make both ends meet. It would be unjust to the electrical industry to assert that it had ignored the refinements of modern engineering practice in meeting the changed conditions. Indeed, in no respect has greater progress been made than in the character of the steam plant of central stations, both for light and power, and we may go so far as to assert that the most modern and up-to-date steam plants in the country to-day are to be found within the walls of the newer electric generating stations. Much ingenuity has been applied to utilize the heat value in every pound of coal consumed, by the employment of compound and triple expansion engines, feed-water heaters, economizers, etc., while automatic stokers, coal and ash handling apparatus have still further increased the economy of operation. The result is that more than one electric central station has a record of 12 or 13 pounds of water per indicated horse power hour. But it would appear that even that high figure of economy can be surpassed by the application of other refinements, and notable among these is superheated steam. This suggestion is by no means a new one, but we doubt if to-day there are fifty plants in this country worthy of the name, utilizing steam in this manner. The reasons to which may be ascribed this paucity of superheated steam plants is, perhaps, to be sought in the difficulties which were encountered in the early application of the system, notably that of lubrication within the steam cylinder. But if one may judge from results attained abroad, notably in Germany, the question of superheated steam is now practically solved, and it ought therefore to be brought to the special attention of all operators of steam plants, both large and small. In an admirable paper on this subject read before the Northern Society of Electrical Engineers, at Manchester, England, Mr. Paul Schou mentions the fact that over 200 complete plants are working successfully in Europe on the Schmitt system of utilizing highly superheated steam, in various parts of the world: among them a 750 h. p. plant, which has been running 3½ years, night and day, continuously, without the slightest hitch. Considering the fact that this engine is used for a mill rolling fine steel sheets, with the engine power varying from 400 to 750 h. p. with an economy of 8¾ pounds of steam per indicated h. p. per hour, Mr. Schou is probably justified in claiming this result to be the best ever obtained on any steam engine in the world. In the present instance the boilers are heated with producer gas, the consumption being equal to 1 pound of coal per indicated horse power hour. Careful tests on a 70 h. p. tandem compound engine, made by Mr. Schou, showed a steam consumption of 10½ pounds per indicated horse power, and a coal consumption of 1.4 pounds per indicated horse power. These instances speak for themselves, and we trust that the lessons they teach will not

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be lost upon American engineers. Of course, sight must not be lost of the fact that such a system of utilizing highly superheated steam entails an added expense of installation. But when one contemplates the figure of 1.4 pounds of coal per horse-power hour for a 70 h. p. engine and compares that with the figures of coal consumption in some of our largest electric light stations, as contained in the N. E. L. A. reports, one shudders at the extravagance.

Problems of the Automobile.

IN the last issue of this journal there was an editorial discussion of the question, who shall build the automobiles, when it was pointed out that in all probability the work would fall largely into the hands of the present bicycle manufacturers and electrical inventors who have devoted their attention to this class of work; not excluding those who have evolved types of steam, oil, compressed air, gas and other carriages for heavy traction and for country traffic. A large problem was thus indicated for solution, but it is by no means the last or the only one that is raised by the new developments in the substitution of mechanical for animal power in the propulsion of vehicles.

Although many classes of carriages have been tried, especially in France, the fact so long insisted upon in these columns has already been demonstrated, namely, that electricity is by long odds the preferable power within cities for this new work. But there is doubt in many quarters as to how the contingencies that arise shall be dealt with; how the market shall be supplied, and how the carriages when sold shall be maintained. It is not until one goes closely and deeply into the various conditions, that the elements of uncertainty and perplexity are fully revealed.

First of all we may say that we do not believe that any great number of carriages will be rented. It will be the natural and obvious policy of the builders to sell as many vehicles of all types as they can and to bring out a new style with improvements each season. Otherwise the capital investment would be enormous and the vehicles would not receive the care they need; so that an extraordinary rate of depreciation might be expected. There will doubtless be electric liveries to take care of casual business, but we cannot help thinking, for many reasons, that more private people than ever, in moderate circumstances, will be able to own carriages for themselves, even if they "board" them in large central repositories. Hitherto many wealthy families in New York, for example, have had stables in the rear of their mansions or in streets rendered thereby well-nigh useless for any other purpose. But with the horses eliminated, it is simply a question of storing the carriage and charging the batteries, leaving the coachman available in many capacities as a spare servant around the house. It strikes us that the costly old private rear stables and the old streets of stables will now disappear. They have had their day and cease to be. Many of the electric carriages will be "up-kept" by central charging stations and called by telephone whenever needed by the owners. One well-known New York millionaire says he will no longer bring his horses from Newport for the winter, and he has authorized the building of three special private carriages which will be handled for him entirely as to care and maintenance by a central company. Our impression is that he is going to save money by the change.

On the other hand, there are plenty of private houses and apartment houses in large cities, and there will be more, whose occupants will own electric carriages, either outright or by clubbing together. In these houses, current is already available. Why should not the carriage be kept right on the premises, just as the bicycle is now? In a great many New York houses the front basement room is often very poorly utilized. The family may breakfast in it, or it may serve as a billiard room, or it may be a lounging place for the domestics. Nothing would be easier in the world than to take eight or ten feet square of that room and run the private carriage in there, ready for instant use. For hundreds of doctors, this would solve at once a difficult problem, and we believe there are scores and scores of fairly well-to-do families that would welcome the chance to "set up a carriage" at the cost of sacrificing part of the semi-useless basement. For large apartment houses, this innovation would be even easier, and it is not unlikely that just as recent houses have announced good storage for tenants' wheels, those built in the near future will advertise that they have abundant and special accommodation for automobiles. Such apartments will be the choice.

The Goodwin Sands.

ANY one who has navigated the English Channel and the approaches to the mouth of the River Thames must recall the famous Goodwin Sands, said to have been once a part of the mainland, but now situated a good twelve miles from the shore, in one of the most populous and intricate pathways ever traversed by the ships of a great nation. We have lying before us at this moment the personal notebook of a Trinity House officer employed in 1846 in marking the buoys, lightships and channels of that course, as familiar to the mariner as are Cheapside and Broadway to city folk of Anglo-American kinship. As we look over this record of data compiled from painful and laborious observation by a master in his profession, it is curious to lay beside it the record which has just reached us of success in sending "wireless telegraph" messages, over the same dim stretches of salt water, from the South Foreland Lighthouse to the East Goodwin Lightship, a distance of which our ancient volume says: "Goodwin Light vessel lies in 9 fath.; the low South Foreland Lighthouse just seen open clear of the cliff S. W. by W. ¾ W.; East Margate N. by W. ¾ W., 10 miles." The men who plotted out with faithful vigilance and skill these bearings fifty years ago little thought that at a time when all the wires in the United Kingdom were snapping and sundering in a tempest, and wire borne messages were taking twenty-four hours to deliver, the Marconi system would be pulsating its messages, without wires, clearly and distinctly, across a dozen miles of storm-lashed, fog-bound sea, from the old lighthouse to the staunch old lightship whose gleam has safeguarded life and treasure without count.

That such work as this can be done by the wireless system must have its effect upon our own authorities, and we venture to hope the American lightships will hereafter no longer swing in dreary isolation at their deep sea anchors, but be brought in closest touch with the shore for daily advice and report, regardless of the weather. It must be remembered that at the time of the Kingstown (Dublin) Regatta last July, Marconi messages were sent twenty-five miles through the air, confirming the belief that life saving and sea patrol work have gained a most valuable new means of communication.

Telephonic Eavesdropping in San Francisco.

TO any one who considers the situation carefully, there are many obvious opportunities for mischief making in the use of the telephone, without the risks that attend sending poisoned candy or medicines through the mail in packages of anonymous origin. But it is not a difficult thing to "spot" the illegitimate user of a telephone seeking to accomplish some nefarious purpose, and the instances appear to be rare in which the evildoer with the telephone as an accomplice has done much harm. A story has come recently from San Francisco bearing on this point, but it is attended with many elements of doubt. The accusation of "The Call" is substantially this: That the telephone company has its employés take down messages passing between its customers, and that these messages are filed away and indexed; that there is a "listening room" connected with the central office and that trusted employees of the company sit therein and make a record of private and important conversations carried on between its patrons, who assume, of course, that the privacy of their communications is strictly guarded; that in the case of customers who desire their telephone numbers kept out of the directory, the company sells the numbers kept to persons desiring them, but having no right to them; that the employees of the company take down important news telephoned exclusively to one paper and then sell it to other papers or otherwise dispose of it to them.

Such practices as these outrage the moral sense of the community, and if supported would condemn the perpetrators and their confederates to sharp punishment not of a lingering, but of a prompt Western type. But we shall need a good deal of convincing. Any one who knows John I. Sabin knows that he does not lend himself to this sort of thing, and he is too vigilant an official to allow such horrible practices to go on in any of his exchanges undetected. These charges should be capable of proof, and proof there must promptly be unless they are to be dismissed with indignation as a contemptuous libel on the whole telephonic personnel of the Pacific Coast.

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TELEPHONY AND TELEGRAPHY

The New Exchange of the Central New York Telephone and Telegraph Co. at Syracuse, N. Y.

BY MAX LOEWENTHAL.

THE OPENING OF THE NEW EXCHANGE.

The Syracuse Telephone Exchange.

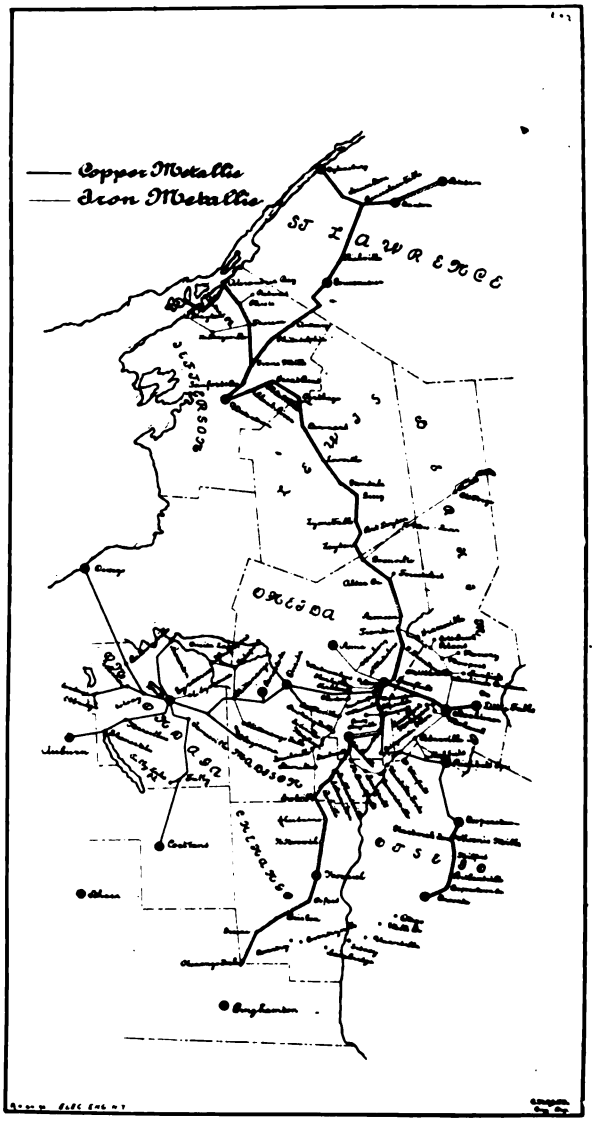
EVER mindful of their obligations to their patrons, and in pursuance of a broad-minded and liberal policy, the Central New York Telephone and Telegraph Company issued invitations to their patrons and friends to attend the formal opening of their new exchange at Montgomery street, Syracuse, N. Y., on Thursday, Jan. 26. Thoroughly appreciated as this courtesy was by the public, it must have been equally gratifying and encouraging to the company to see so many prominent citizens in every walk of life in Syracuse, Utica and the surrounding territory, attend the housewarming, and express their hearty appreciation of the prompt service they have been receiving. To make the housewarming complete luncheon was provided, and that this hospitality was thoroughly enjoyed can be gathered partly from the fact that over 1,800 covers were served. During the day about 2,500 visitors were inspecting the various departments of the exchange, each main feature being numbered and referred to in a specially prepared catalogue, and each lady visitor receiving a souvenir in the shape of tiny telephone receiver.

The five-story building covers a space of 33x56 feet, and is 80 feet high. It is located in the very heart of the business district, and is entirely occupied by the various departments of the local company. A Morse & Williams electric elevator connects the various floors, which are devoted to the following purposes: In the basement are located the incoming underground cables, the main distributing frame, the switchboard cable run, the power plant, the storage battery, ringing generators, power switchboard, wire chief's testing table, supply room and elevator machinery. On the first floor are the local manager's office, the cashier's and bookkeeper's department and the reception room. The second floor is vacant at present, but will in the near future be occupied by other departments of the company. On the third floor are the offices of the general superintendent and his technical assistants and the draughting rooms. On the fourth floor are the repair shop and the operator's cloak and retiring rooms. On the fifth floor is the operating room, including the main board, chief operator's and trouble clerk's desks, toll and long-distance board, the intermediate distributing frame, relay racks and fuse board, as well as the ends of the cables as they emerge from the shaft through which they are carried from the basement to this floor.

Before making a trip through the building to examine the plant in detail, let us turn for a few moments to the affairs of this progressive company itself.

HISTORICAL.

The Central New York Telephone and Telegraph Company was organized in 1882 by a number of Utica business men, being a consolidation of five Bell interests, namely, those of Utica, Rome, Watertown, Oneonta and Ogdensburg, which had been doing a small business for three or four years previous to that time. There were then about 500 subscribers on the combined lists, and the company were the first to give telephone service in central New York. They immediately began to reach out and build toll lines, the first being the one connecting Utica and Rome, continuing from Utica east to the Mohawk Valley. All of these circuits were grounded, and switchbords, with trunks, were employed. Then followed the period of crude development and expensive reconstruction experienced by all licensees, but the company kept up with the march of constant improvement, and to-day stands practically alone in that enormous territory covering eleven counties, as large, perhaps, as Scotland or Ireland. It is a complete strip of land across the State bounded by Canada on the north and Pennsylvania on the south. Within this rapidly populating territory are ten exchanges, 4,330 miles of toll wire, 1,830 miles of pole line, and 2,600 miles of overhead wire on exchange work. In Syracuse and Utica alone there are 3,900 miles of underground circuits. The longest line



MAP SHOWING TERRITORY COVERED BY METALLIC CIRCUIT OF THE CENTRAL N. Y. TEL. &. TEL. CO.

wholly within the company's territory runs from Potsdam on the north to Oneonta on the south, a distance of 263 miles, and works very satisfactorily. The company have 177 regular employees on their pay roll, and their headquarters are at Utica. The rates of the company are very reasonable, being for unlimited long distance metallic service within one mile of the exchange from $39 to $80, and for measured long distance service $30 to $80, according to the class of service.

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THE SYRACUSE EXCHANGE.

The Syracuse Exchange supplies 2,000 subscribers, though the present switchboard is wired up for 2,500. During the recent change from the magneto system to the new multiple, common battery, branch terminal metallic system, there was no interruption of service, as the old and new exchanges were connected by temporary trunk lines. The new exchange, besides embodying the latest appliances known in the telephonic art, contains some features which are said to make its board and service superior to that of any exchange in the country. Among these may be mentioned the convenient relation between the local and long-distance boards, the employment in so large an exchange of visual signals, in place of miniature lamps, and the company's arrangement with the local fire department, all of which will be referred to later.

It was on Aug. 15, 1897, that the city granted them the franchise, by request, permitting them to build subways and put their wires underground. It was also decided at that time that the city should not attempt to build a subway of its own for reasons which were so obvious that little opposition to it was encountered. The company immediately began to put their wires underground, and on Dec. 6, only 112 days after the work began, it was completed, streets repaved and overhead wires taken down. In this work 120,509 feet of single duct Camp tiles were used, or over 80,000 1½-foot tiles. Thirty-five manholes were constructed, the average length of a section being 360 feet and the total length of the subway, 10,500 feet. There are 37 distributing points, the wires being fanned out either from poles, such as is shown in the illustration, or from rings mounted on the top of buildings. At one point it was necessary to go under the Erie Canal, and for that purpose eleven 4-inch wrought-iron pipes were laid three feet below the bed of the canal. The pipes were laid on six inches of concrete, surrounded by cement, and the whole was imbedded in concrete. Through these pipes the 100-pair lead-covered cables were drawn.

In all, twenty-eight of these cables are at present concentrated at the office manhole, from which point they enter the basement of the exchange.

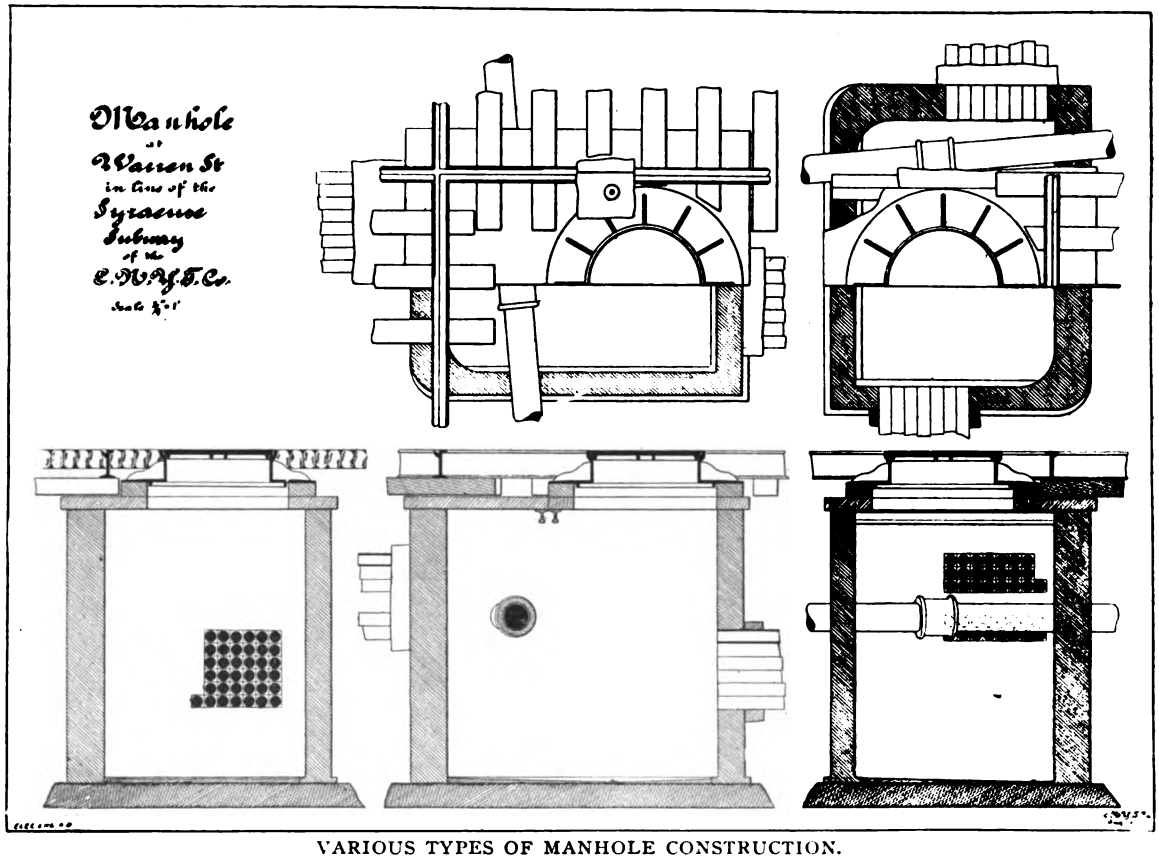
We shall now make a trip through the building, and trace the 2,800 pairs of wires from the office manhole to the switchboard.

CABLE RACKS AND MAIN DISTRIBUTING FRAME.

Upon entering the basement, the twenty-eight 100-pair cables are supported on vertical standards, provided with brackets, all of which are numbered to correspond with similar numbers of the cables which they support, and this numbering is carried out throughout the entire system, in order to facilitate the locating of a fault or disturbance. From here they are led to the horizontal side of the main distributing frame, where the 200 wires in each of the twenty-eight cables are fanned out and soldered to clips arranged horizontally along the board, and numbered for convenience, with respect to the cable to which they belong. This side of the frame has an ultimate capacity of 7,200 pairs of terminals arranged on ten horizontal shelves. On the opposite, vertical, or arrester side of the frame are connected the wires of the 20-pair switchboard cables, which are numbered to correspond with the subscriber's numbers on the switchboard. The wires on the horizontal and vertical sides of the frame are connected by flame-proof cross-connecting wires, called "jumpers."

DISTRIBUTING POLE.

A very important feature of the main distributing board is the precautionary means adopted for protection against the action



VARIOUS TYPES OF MANHOLE CONSTRUCTION.

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of lightning and high tension currents due to a cross on the line. The device employed to protect the operator and the switchboard apparatus against the effect of lightning, consists of two carbon plates insulated from each other by a fine strip of mica, one of the plates containing a small cavity filled with fusible metal and grounded. The instant a flash of lightning passes over the wires the arc jumps across the plates and passes to the ground through the grounded carbon, thus diverting the course of danger from the switchboard. The sneak current protector, intended for cases of accidental cross on a subscriber's line, with an electric lighting or power circuit, consists of a small coil of German silver wire wound on a hollow brass spool. A short metal rod passes through the hole in the spool, and is held in place by a drop of fusible alloy, the whole mounted in a small fibre case. This contrivance is supported between two springs. When a current of abnormal strength flows through the circuit, the wire, on heating the spool, melts the metal, and, releasing the pin, grounds the line, thereby opening up the line in the exchange. In this way danger is averted which might otherwise cause havoc in the exchange. If the cross remains on, the fuse at the cable terminal is blown, and prevents damage to the cable itself.

At the main distributing board all changes are made due to the removal of instruments, changes in location of subscribers and new connections.

INTERMEDIATE FRAME, RELAY AND COIL RACKS.

From the vertical side of the frame the 20-pair cables are led through the cable shaft to the intermediate cross-connecting frame on the fifth floor. In appearance, this frame is very similar to the one in the basement, with the exception that the protection devices are missing. This frame serves as an intermediary connection between the main frame and the switchboard. Its office is to permit of a rearrangement of lines to any operator's position for the purpose of equalizing the calls received over her lines. In this way it is a simple matter at any time to balance the amount of work shared by the operators. The frame has an ultimate capacity for 4,600 subscribers' lines and 200 trunk or other lines, the present equipment being for 2,100 subscribers' and 200 trunk or other lines. From the horizontal side of the frame the wires pass to the multiple jacks, and are also connected by jumper wires with the vertical side, to the answering jacks and the cut-off relays on the relay rack. This rack, as its name indicates, contains the relays and resistances for controlling the signal lights on the main switchboard. The rack has a present equipment of 2,120 line and cut-off relays. 2,100 for subscribers' lines and 20 for local trunk lines. It is built for an ultimate capacity of 4,800 relays.

Near this rack and adjoining the intermediate board is the coil rack, on which are mounted on 14 horizontal shelves 289 repeating coils. The ultimate capacity of this rack is 714 coils.

THE MAIN SWITCHBOARD.

From the intermediate distributing frame the wires are carried to the switchboard in a running box placed upon the floor. This board, which embodies principles and improvements of the most modern and advanced type, consists of six subscribers' sections and two-thirds of a switching section, with three operators' positions at each section. It is finished in mahagony, stands about six feet high, is four feet wide and has an overall length of about fifty feet. Its construction is based on the multiple, common battery, branch terminal, metallic system. It is at present wired for 2,100 subscribers and 20 trunk lines, and has an ultimate capacity, when completely installed, of 4,200 subscribers' and 200 trunk lines. The end, or switching section, is reserved for the incoming trunk lines, and here one operator has the responsibility of making all trunk line connections. The following figures as to some of the apparatus in this section may be of interest. The trunk line relays have a resistance of 30 ohms. The double-wound relays must operate when .1 ampere flows through both windings. The armature does not drop off if up, nor is it drawn up when .1 ampere is flowing in the winding in series with the shell of the plug. The resistance for the ringing circuit is 200 ohms, and there are 600 ohms in the operator's telephone set. The condenser has a capacity of two microfarads.

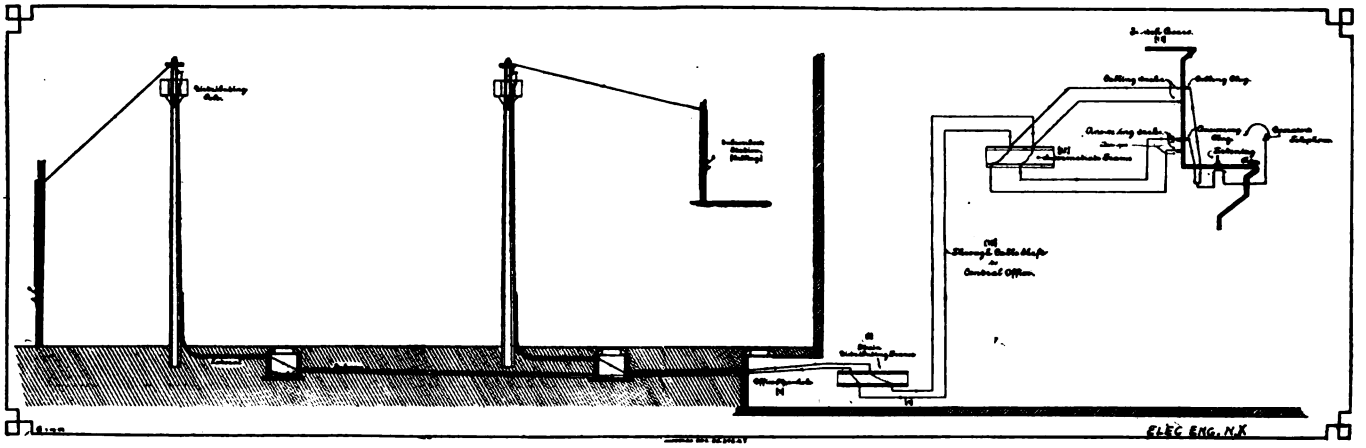
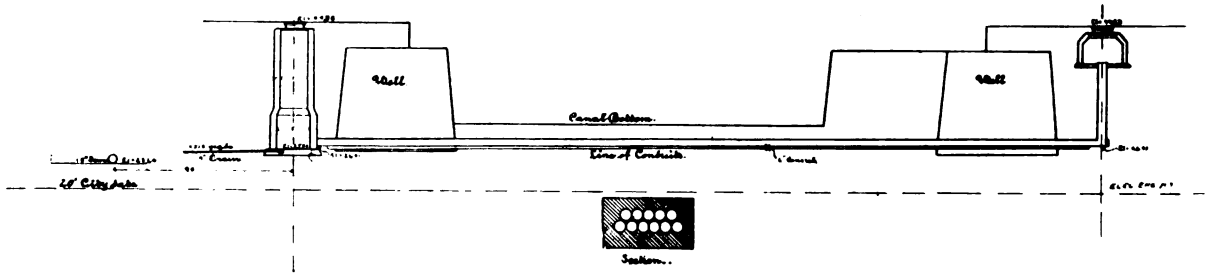


DIAGRAM SHOWING COMPLETE SYSTEM FROM DISTRIBUTING POLE TO SWITCHBOARD.

As implied by the term "multiple," all the subscribers' lines are multipled in each of the sections of the board. Each operator, although occupying one-third of a section, has a third of a section to the left and a third to the right at her disposal, in this way having within reach one complete section. As all the subscribers' lines terminate in every section, each operator can readily complete a connection without transferring to another operator.

There are, in addition to the 2,100 multiple and 20 trunk jacks, 320 answering jacks appearing only in that particular section and representing the set of subscribers' lines over which the three operators receive their calls.

The arrangement for signalling the operator when a connection is desired is automatic, and consists in the use of miniature electric lamps, controlled by relays and suitable resistances, referred to above. Upon the glowing of these lights and a larger



CONDUIT CONSTRUCTION EMPLOYED IN CROSSING ERIE CANAL.

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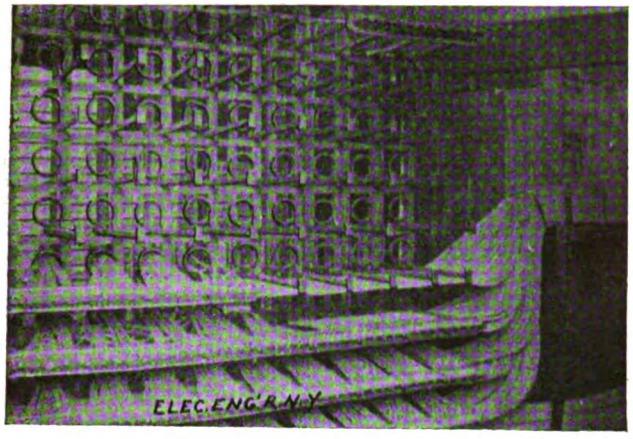
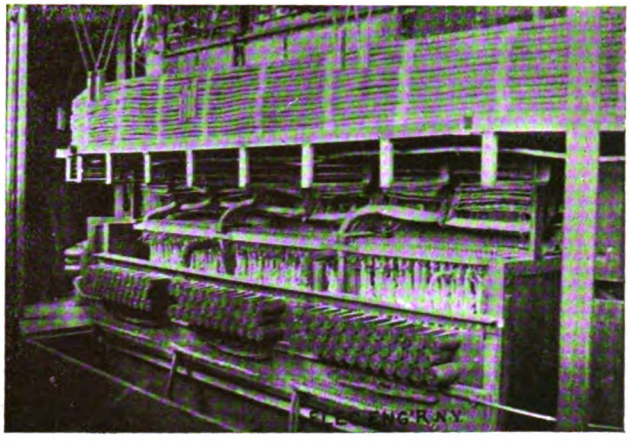
pilot lamp in front of the operator to attract attention, it is at once known what subscriber has removed his telephone from the hook and desires a connection. On a horizontal keyboard below the jacks just referred to is a double row of plugs at the operator's command, the rear set intended for insertion into the answering jacks, the front set being only used to connect with the calling jacks. Corresponding to and connected with the two sets of plugs are a double row of miniature magnetic cord



INTERMEDIATE CROSS-CONNECTING FRAME.

visuals, operated by relays, whose office it is to indicate when the parties have ended their conversation. In place of these visuals, several modern switchboards employ miniature lamps, but it is claimed that the visuals last longer and give better service.

The keyboard is so constructed as to admit of party line service, where two subscribers are connected on the same circuit, one subscriber's signaling apparatus on each side. Each operator's position is equipped with ringing and listening keys corresponding to the plugs at her command. The operation of completing a connection is comparatively simple. A subscriber, on removing his telephone from the hook, preparatory to calling



BACK OF SECTION OF SWITCHBOARD.

When conversation between subscribers has ended, and the receivers are replaced on the hooks, the little visuals connected with the cords of the corresponding plugs, and which have been down during the conversation now jump up, indicating the disconnect signal to the operator. In general, while the lines are connected it is evident that when the receivers are off the hook the visuals are down, and when replaced they are up.

TOLL BOARDS.

In addition to the main switchboard there are three toll and long-distance boards where the connection is made between any local subscriber and any one on a trunk or long-distance circuit.

OPERATING ROOM, CENTRAL NEW YORK TELEPHONE AND TELEGRAPH CO., SYRACUSE, N. Y.

up another subscriber, indicates this fact by the simultaneous glow of the lamp corresponding to his line in the exchange. The operator immediately inserts an answering plug in the jack above the lamp, thus extinguishing it, and, on throwing over the listening key opposite the plug, communicates with the subscriber, calling "number." Upon receipt of this, the operator

The order to make this connection is received from the switching operator who has previously received the order from a line operator and switched the subscriber on that particular trunk or long-distance line. For registering the time consumed during a conversation, calculagraphs are being used. These have been fully described in The Electrical Engineer.

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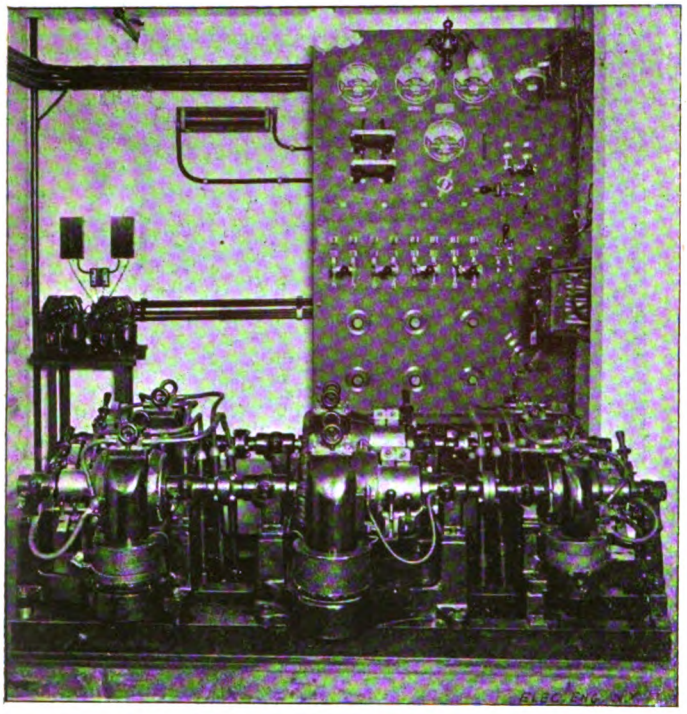
CHIEF OPERATOR'S DESK AND THE WIRE CHIEF.

In the centre of the operating room is situated the table of the chief operator and her assistant. They are, as is well known, a sort of "policemen" of the exchange, seeing that every girl attends strictly to her duty, and the persons to whom everybody tells their troubles . But the former duty is chiefly in mind, for



POWER PLANT SHOWING MOTOR GENERATORS AND SWITCHBOARD.

the troubles are at once communicated to a "trouble" clerk, who in turn makes a complete record of the trouble, and reports it to the wire chief, whose testing table is located in the basement.

As the neglect to locate telephone troubles and to supply an immediate remedy is the first and principal cause for the subscribers to grumble and feel dissatisfied, this company have so systematized the trouble system that we deem it of sufficient interest and value to say a few words about their method.

It has been found by the company that all troubles and complaints can be classed under the following heads: 1—Light remains lighted. 2—Lamp does not light. 3—Cross. 4—Noise. 5—Transmitter. 6—Hearing. 7—Bell. 8—Cannot call subscriber.. 9—Receiver off. 10—Cuts off. This list is in the hands of the trouble clerk, and when she hears of a complaint she looks at the list and sees under what heading it falls. She then makes out a trouble ticket which consists of three separable stubs. The top one is called the chief operator's check, and contains: Number of trouble, date, operator, time, lamp on board, multiple number and name of subscriber. This she keeps as a record. The next is the trouble ticket proper, and has on it the above material, is signed by the chief operator and is sent to the chief inspector. He fills out instructions to the repair man, who fills out his report below his order, stating work done, where the trouble was, and when the work was finished. This check is signed by the repair man and the chief inspector. In the meantime, the latter has kept the lowest stub, namely the chief inspector's check, which he fills out when repairs have been made, and both are returned to the trouble clerk. She, in the meantime, had kept her check on her table, and awaits the return of the other stubs within 24 hours. If they do not come back in that time, an overdue trouble ticket is made out by the manager, and on that the chief inspector must explain the delay. A similar though not quite as elaborate a system is followed in case of switchboard troubles. All cases, after the stubs have been returned, are carefully entered on file cards, and these are looked over every month by the chief inspector. If he finds that a certain trouble has been repeated several times during that period, he at once makes that a special subject of investigation, locating the fault either in the apparatus or finding that it lies with his men

AUXILIARY FIRE ALARM.

Another feature of the chief operator's desk is the auxiliary fire alarm arrangement, all fire engine houses and the chief being connected to her board. In case of fire, all one has to do is to call up the central office and notify the operator where the fire is located. The chief operator immediately moves a switch which rings a gong in the chemical fire house and drops the harness on the horses in front of the chemical engine, giving that apparatus about ten seconds advantage over every other. At the same time the chief operator rings the circuit on which all the engine houses are, for about ten seconds, and at the end of this time a fireman is at the telephone in every engine house. Then the chief operator tells the location of the fire, and all the firemen hear it at once. A glance at a large card which hangs in the engine house would tell the fireman whether the location is one to which his piece of apparatus responds. He generally knows the card by heart and doesn't have to look. A large proportion of the alarms sent in from the business district come by telephone. Out of 130 alarms received at No. 6 house last year, 30 were by telephone. The proportion of telephone alarms is increasing.

And so we realize the importance of the chief operator, the trouble clerk and wire chief, who look for outside as well as inside troubles. That the latter may be a considerable item can be gathered from the fact that there are about 130,000 soldered connections between the terminals of cables on the main distributing board and the operators' switchboard.

The entire equipment of the exchange was furnished by the Western Electric Company, including the 100-pair cables used in the conduits. The 200 conductors are of hard drawn copper No. 19 B. & S. gauge, paper insulated and twisted in pairs, the whole being encased in a heavy lead sheath. Before it was accepted each cable was tested for capacity not to exceed .08 microfarads per mile, and the insulation resistance not to fall below 500 megohms per mile. Wire used throughout the exchange was furnished by the Okonite Company, Western Electric Co., Safety Insulated Wire Co., American Electrical Works, Roebling's Sons Co., and Washburn & Moen.

THE POWER PLANT.

Located in the basement is the power plant, which has become a necessary adjunct to a modern telephone exchange, replacing the troublesome primary cells which were required at each subscriber's instruments in the old magneto system. Here are housed the storage cells, the centralized power of the exchange, as well as the generators for supplying them with current, the power switchboard and the motor generator for ringing. In the battery room two sets of storage cells are installed, one consisting of two cells of style 15G Chloride accumulator for operating the visual signals. The normal useful capacity of these cells is about 1,000 ampere-hours. Thirteen cells of the same type deliver the talking current over the lines. They are charged at the rate of 120 amperes and 28 volts. The discharge is at 24 volts, while the current necessarily varies, ranging from 2 to 15 am-

GENERAL SUPT. W. W. NICHOLSON.

peres. A 100-ampere end cell switch has been installed, enabling the charging and discharging of the cells to be accomplished simultaneously. A fuse board equipped with the necessary fuses, 42 arresters for the ringing circuits, and 21 104-volt 16 c. p. lamps, have been installed on the fifth floor.

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These cells are charged by means of a motor generator of 3,000 watts capacity, furnished by the Crocker-Wheeler Electric Co. It consists of a motor and two generators mounted on a single base, the motor receiving current from the central station of the Syracuse Electric Light and Power Co., at a pressure of 500 volts. The larger generator charges the 13 cells furnishing the talking current at 28 volts and 120 amperes, while the smaller one delivers 120 amperes at a pressure of 6 volts for the 4-volt battery, which furnishes current for the operation of the cord visuals and transmitters. This motor generator was built so as to stand an overload of 25 per cent. for two hours. It is compound wound, so that a drop of 5 per cent. between zero load and full load will not sensibly affect the e. m. f. at the terminals of the machine. It is run at a speed of 900 revolutions per minute.

An auxiliary equipment has been installed to provide against any possible breakdown of the other machine or a failure of the station to deliver current. It consists of a 500-watt motor generator, the motor receiving current from the isolated plant in the University Block at a pressure of 110 volts, and the generators delivering current at the same pressure as those mentioned above.

Besides these machines, there has been installed a motor generator for ringing purposes. The primary circuit is designed to operate on a circuit, the potential of which varies from 22 to 27 volts. The secondary circuit is designed to deliver an alternating current of one ampere at an e. m. f. of 75 volts, and is capable of delivering continuously 75 watts, the current being between 900 and 1,000 complete alternations per minute.

In a convenient location near the motor generators is the power switchboard, on which are mounted 24 arresters and fuses, six 50-ampere d. p., four 200-ampere d. p., and one 100-ampere d. p. switches, one d. p. double throw 25-ampere switch and one d. p. seven throw voltmeter switch; two 300-ampere s. p. underload circuit breakers for the charging circuits, two Weston station ammeters, reading from 0 to 300 amperes, and two reading from 0 to 150 amperes. and one Weston station voltmeter reading from 0 to 50 volts. Rheostats and resistances are mounted on the back of the board, and the front is illuminated by four 110-volt 16 c. p. lamps.

OFFICERS OF THE COMPANY AND MANAGEMENT OF THE EXCHANGE.

The officers of the company, whose headquarters are at Utica, N. Y., are: President, Robert S. Williams; vice-president, Lewis H. Lawrence; secretary and treasurer, Francis G. Wood; general manager, Charles A. Nicholson, all of Utica, and general superintendent, Walter W. Nicholson, of Syracuse. Mr. George W. Wood is the superintendent of toll lines. The Board of Directors consists of Robert S. Williams, Lewis H. Lawrence, Francis G. Wood, Charles A. Nicholson, David B. Parker, of Buffalo, and Martin A. Knapp and Warren H. Girvin, of Syracuse.

Mr. C. A. Nicholson, the general manager of the company, has long been a central figure in the telephone business in New York State, for he started to make telephones soon after Bell's discovery was announced. In fact, his work aroused so much attention that he was looked upon as an infringer, and the Bell Company, in recognition of his early work, made him their agent for central New York. Closely associated with him in all his early labors was his son, Mr. Walter W. Nicholson, now the very efficient general superintendent of the company. As far back as 1880 he was night operator, and his experience was acquired in every possible branch of the art. His latest triumph is the splendid exchange which we have described above, second to none in this country for quality of equipment, thorough discipline and the high esteem in which it is held by the community. Of late years he has been ably assisted by his brother, Mr. W. S. Nicholson, who, having had a thorough scientific training, attends to the technical matters of the exchange, and the result of his careful engineering is evidenced by the admirable underground work done by the company as well as the very efficient working of the exchange.

On Mr. W. L. Burdick, the manager of the Syracuse exchange, fall directly the burdens of the management of the company's affairs in that city, and his practical telephonic experience and executive ability are evidenced in every department.

Mr. Edward Rathbun is the technical assistant of Mr. W. S. Nicholson, and to him is entrusted most of the draughting and the attention to technical details. A very ingenious electrical combination lock designed by him has been attached to the door leading to the operators' quarters, and from there to the exchange. Others holding positions of responsibility are Mr. B. A. Cornish, the wire chief; Mr. J. E. French, who has charge of supplies, and Miss Helen Ormsbee, the chief operator, who has been in the company's employ ever since its organization.

In conclusion, we wish to express our warm thanks to Messrs. W. W. and W. S. Nicholson and Mr. Edward Rathbun for their valuable assistance in the preparation of this article.

Utilization of Exhaust Steam.[1]

BY J. H. HARDING.

ALL who have given thought to the many practical economies possible to be practiced in connection with an electric plant, have figured more or less upon the utilization of the heat going to waste in the exhaust steam. As only a small percentage of the heat contained in the exhaust steam can be used to heat the feed water, the question naturally arises whether the remainder can be utilized. If so, how to the best advantage?

In looking for a means of utilizing the surplus, we find several systems being promoted for heating by exhaust steam. Personally, I have had little knowledge of heating buildings with exhaust steam, at either near or distant points from a central station. My inquiries along that line led me to the conclusion, however, that, while some plants were reasonably satisfactory, others were giving much trouble. The reports indicated that as the load and distance increased, the trouble also increased. Another objectionable feature was the great expense of construction. An economy or saving is of advantage only when it can be utilized without too much outlay of capital.

While investigating we heard of a system in which the heat of the steam was transferred to a volume of water, and that being circulated through a supply and return pipe, delivering the heat to the buildings to be heated. After a careful investigation of the Yaryan system, as it is called, the La Porte Electric Co., of which I am superintendent and manager, concluded to install it at La Porte in 1897.

We find that it is possible to heat buildings within a mile of the station, thus giving a large field to draw custom from, permitting us to go to the residence district, and not to be confined to the business section only. This has been a good thing for us, for while we have our mains in the alley behind seven blocks of business houses, our income is less than 20 per cent. from that source.

We have a line running one mile out through the residence part of the city, nine residences being heated located within one block of the end. Again, our station being located at the highest point in the city, made it difficult to return the condensed water from steam mains. With this system it makes no difference; both lines being full of water one balances the other, making it possible to supply heat above or below the station.

One of the strongest features in favor of the system is, that as the water is returned to the station, after it has passed through the buildings to be heated, it suffers no waste of heat, except the amount radiated from the pipe line, and that sold to the customer. That is to say, that if we send out water at 160 degrees, the return would be 130 degrees, so by raising the water 30 degrees, it is up to 160 degrees, and ready to go through the line again. The difference in the amount of heat that would be lost by radiation from the mains, whether they were of an average temperature of 220 degrees, as with steam, or only 160 degrees, as with water, was an important item that we took into consideration.

There are many features of economy connected with the system that will appeal to the central station man when brought to his attention, that would seem too much like an advertisement were I to introduce them here. Suffice it to say, we are satisfied we have a practical way of utilizing all of the exhaust steam at our station.

DISCUSSION.

In answer to a question, Mr. Harding gave the following de-

[1]Abstract of paper read before the N. W. Elec. Assoc.

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scription of the arrangement for the storage of exhaust steam: We put in a storage tank of about 55,000 gallons. We found in practice, as we have increased the output of the plant, that during all seasons of the year when the thermometer ranges 50 degrees or above, we are able to store up sufficient heat in this storage tank to furnish our mains and maintain proper temperature in the different houses, by simply circulating the water from the tank.

As to the method of connecting up, we have our mains so arranged that we can run the water back through the tank, or by a by-path direct to our pump on the return main, thereby enabling us to draw a sufficient amount of hot water from the tank to bring the temperature up to what we wish on the mains. We regulate the temperature of our water at all times to correspond to the temperature of the weather outdoors, thereby maintaining a uniform temperature in our houses.

MR. THAYER: While this system presents quite a number of new features, yet it has been in use for several years, and appears to give good satisfaction, but it might be of interest to bring up some features not yet determined in connection with the subject.

The first thing that occurs to me is the liability of the mains to corrode. The New York Steam Heating Co., who were the pioneers in the distribution of steam, put in a system of return mains which returned the water of condensation. They found that these mains were subject to such rapid corrosion that it was cheaper to abandon their use and simply waste the water of condensation, and the question comes up whether the same corrosion will not appear in these pipes, even though the temperature is much less than it would be in the case mentioned.

The cost of pumping here is a feature with which I have had no experience, although I have had considerable experience with steam—but the cost of pumping with a 30-foot head of water with a 30-degree temperature head, that is, from 160 degrees down to 130 degrees, with 30 pounds of water per horse power per hour on your engine, and 150 to 250 pounds per indicated horse power on your steam pump, when it will take about three pounds of steam to maintain your circulation on a horse power of exhaust heat from your engines, and while, of course, that factor during the lightly loaded portion of the day cuts no figure, yet during the maximum, or during the time that you have to waste part of your exhaust steam, or something like that, it would cut some figure.

Another thing is the prospect of whether you are ever going to be able to meter your heat. It is very difficult to prevent a man from wasting his heat. Some men, of course, will be careful, but we know how that works in contract lighting where there is no check whatever, and I know that customers would take advantage of any wide open heat deal in the same way.

The station appliances, of course, I do not suppose have been worked out. But few appliances have been put in, and the whole thing is recent, and we must not criticize the system unduly now, but I should very much like to hear from Mr. Stahl on the details or arrangement of his storage tanks. Some of the time they must deliver their water at a higher temperature than the water in the tank, and they must have a special arrangement for heating the water quickly and sending it right out quickly, and if they depend on their storage tank it may take several hours.

MR. STAHL: To answer Mr. Thayer's question regarding corrosion. He states that it is found to be impracticable to return condensation from the steam plant back to the station. There are steam plants used now where they put an exhaust pump on the return end and draw the exhaust steam into the radiators and prevent back pressure upon the engine. I would not disparage anybody else's system, but will speak only of the question raised by Mr. Thayer. Water, having been converted into steam, drops all its solids and is pure water.

In reference to the control on the inside of the building itself, in individual places, Mr. Stahl stated that they control it by raising and lowering the temperature of the water. He bought a water motor for his own use to furnish the power to compress the air. The valve acted perfectly. He set the thermostat to hold the house at 72, and did not open or close a valve all last winter, nor all summer. He provided a by-pass just back of that thermostatic valve, to take water from the system across the house boiler so as to heat the city water for domestic use. The water motor was running on the same pressure all the year through, and the thermostat shut up the valves so no hot water passed to the radiators in the summer time. At the same time, whenever the temperature dropped below 72 the radiators received the right amount of hot water to keep the house at just the right temperature, and the regulation was perfect.

In answer to a question as to how the radiation required is figured, Mr. Stahl stated: We take the cubic contents of the room. That is one of the things, but glass has a great influence, and exposed wall has a great influence. I have an illustration that I use in talking to individuals. Take a room 15x16x10 feet high, with one window 4x6 and another 3x6, and another 2½x6. The room is an L to a house, and that figures out by the rule 102 feet of radiation. Take the same room and let the side of the house start at 4 feet from the corner, and the other 3 feet, and you have got out some exposed wall. Now, leave out the 2½ x6 window, still leaving the 4x6 in and the 3x6, and that takes 72 feet. So, if you divide it by cubic contents you would not get the proportionate amount of radiation. We add up the amount of radiation of each room and multiply it by a fixed charge, which charge at La Porte is 12½ cents.

This charge varies at different places, going up as high as 15 cents. They charge 25 cents a square foot for steam radiation in every plant I know of, even where coal is plentiful. With regard to the relation between the radiation surface and the equivalent surface of glass, the rule extended is to take the cubic contents, divide the square feet of exterior surface by 5, 7, 8, 12 or 15, according to its construction, to reduce it to glass. A well constructed frame building lined with paper, well painted so that the siding lies down flat, may be divided by 10—10 feet of exposed wall will lose as much heat as one foot of glass. If the building is old and loose, be careful and divide by a small figure, so as to give a relatively large amount of equivalent in glass. Difference in construction determines the divisor. Having reduced it to glass, multiply the total of glass by 75, which will reduce it to its equivalent in cubic contents, and the glass exposed wall is nearly always in excess of the cubic contents. Now, for the first story we multiply that by the fixed decimal .011, the second story by .0081, which is ¾ as much, for heat rises, and the upper story is more easily heated than the lower. We figure the upper hall for the quantity, and add it to the radiation of the lower hall, putting it all down below, for the upper hall is always warm enough.

Replying to the qusetion as to the average cost of equipping a house, Mr. Stahl said: We can have a profit by charging in territory east of the Mississippi River 10 cents a square foot. The usual price is 40 to 60 cents for hot water apparatus put in by plumbers. In an eight-room house there are required probably 600 feet of radiation, which, at 30 cents a foot, makes $180. We make a flat charge of $20 for the thermostat. The whole apparatus complete can be installed for $200. Then we also make a flat charge of $25 for each job for service connection—that is, for piping from the main line, boxing, corporation cock, etc., which would be $225 for equipping an eight-room house, a little more than it costs for a good hot air furnace, and not more than it would cost for steam radiation. Now, even though we set four square feet of radiator surface, the cost of the piping and the fittings and the labor and the valves, is so much less that the cost of the job is less than it would be for ordinary hot water or steam fitting.

As to the cost of furnishing the heat, say, for an eight-room house, such as has just been described, 600 feet of radiation at 12½ cents is $75. The cost, we have frequently been told, is less than the fuel bill, and besides that you avoid coal ashes, the expense of renewing boilers and furnaces, and have the convenience of securing an even temperature at all times. The house is always warm. A gentleman at Springfield, Ill., president of a bank there, told me that it cost $125 to keep his home warm; then I said to him at once, you use hard coal, although you have soft coal right here. He said, certainly. I said, why? He said it is cleaner and more convenient. Yes, and I said, you would pay $25 more if there was no furnace about your place, no coal or ashes or dust to settle on the carpets and furniture and no noise and no attention necessary.

MR. E. WILSON writes: "I carefully bind every volume, and hold The Electrical Engineer in very high esteem as deserving the confidence of all who seek instruction in electrical science, and you will greatly oblige me by sending the missing number to me here. I enclose back payment for ensuing volume, fearing that I might repent if I do not have the benefit of your journal's weekly visit."

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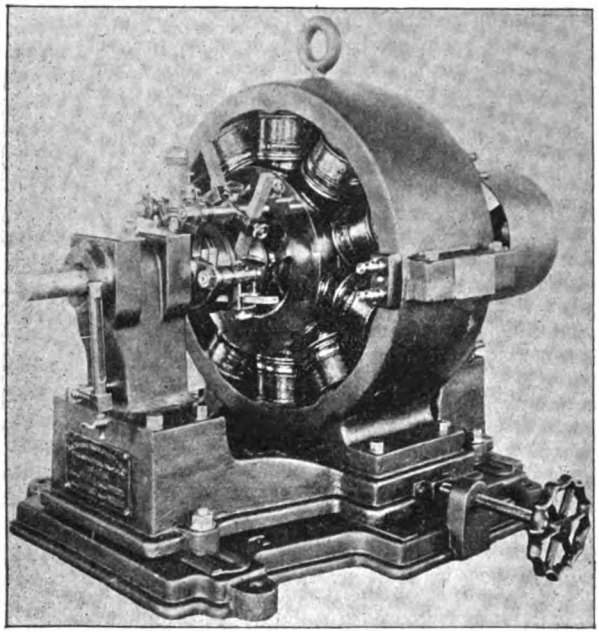
EDUCATIONAL

La Roche Alternator for Scientific Purposes.

THE cut herewith illustrates the "Ideal" alternator, manufactured in all sizes up to 150 k. w. by F. A. La Roche & Co., of New York City. This firm makes a specialty of building experimental alternators for colleges and scientific laboratories, the following being a partial list of institutions and testing laboratories of manufacturing firms supplied with alternators of their manufacture: Stevens Institute, Georgia School of Technology, University of Wisconsin, Pennsylvania State College, Drexel



LA ROCHE ALTERNATOR FOR COLLEGES.

Institute, Yale University, Alabama Polytechnic Institute, Queen & Co., Bristol Co., Hunter Fan and Motor Co., Ward Leonard Electric Co., Ironclad Resistance Co., Diamond Electric Co., Lakon Co., Keystone Electrical Instrument Co., Empire Electrical Instrument Co., Fleming-Spence Electric Co. and the Dupont Laboratory. These experimental machines are generally of small size, and the following description of the 5 k. w. three-phase alternator, furnished to the Alabama Polytechnic Institute, which is referred to elsewhere in these pages, brings out the main features of this type of machine.

This alternator is designed to generate three-phase currents at 220 volts, and is therefore supplied with three collector rings, between any two of which it is possible to obtain a current of 13.3 amperes and 220 volts, when the armature is revolved at a speed of 720 revolutions per minute. Two additional pulleys are provided, by means of which it is possible to drive the alternator at 600 revolutions per minute and 420 revolutions per minute, at which speeds the voltages 180 volts and 100 volts, respectively, are obtained, the field excitation being maintained constant at 110 volts.

The field frame is a massive steel casting with 10 poles. The 10 field spools are connected in series, each consisting of 410 turns of No. 14 B. & S. wire, requiring a field current of 3 amperes at 100 volts to excite the field at full load. The armature is 10⅞ inches in diameter, is of the tooth type, and provided with 60 slots, each 11-32-inch wide and ⅞-inch deep.

The core is built up of discs of the best grade of soft sheet iron, and the winding, which is embedded in the slots, is well insulated from the core. The portion of the winding at the ends of the armature is thoroughly protected from injury by two ornamental brass end shields, provided with openings of sufficient size to allow free circulation of air and excellent ventilation. The 60 slots above mentioned provide space for 30 coils, each of which consists of 21 turns of No. 12 B. & S. wire. These 30 coils on the armature are divided into three groups of 10 coils each, and the three groups joined together in star fashion. The coils are connected around the armature in regular order to the first, second and third groups. The two halves of a coil are separated by two slots. When all the coils are connected to the three groups, the three starting ends are soldered together and well insulated. The three finishing ends are brought to the three collector rings.

The bearings are of the self-oiling type, and the armature so well balanced that there is no vibration, even when the machine is driven at the speed of 2,500 revolutions per minute. For varying the degree of tension on the belt, a hand wheel and belt tightener are provided on a special sub-base furnished with the machine.

This company also builds larger alternators for single, two or three-phase currents, and winds the armature for any voltage up to 2,000 volts. The fields can be furnished either separately excited or provided with a composite winding; the latter is excited by a portion of the total armature current, which is rectified by passing through a special commutator. By this means the field excitation is increased as the load increases, and by making the proper adjustments and degree of compounding can be obtained.

F. A. La Roche & Co. would be pleased to receive inquiries in reference to these alternators, and are prepared to build special machines, according to engineer's specification.

ELECTRIC LIGHTING.

Some Observations on Acetylene.

BY HARRY L. TYLER.

A LITTLE more than a year ago there was formed in Western New York a company to make acetylene generators. The promoter of the enterprise did not tell what he knew—if he knew anything—about acetylene. On the contrary, he kept the air full of rumors about the delivery of carbide to consumers for ½ a cent a pound. Of course, the death knell of electrical and common gas interests sounded in the ears of the people that bought acetylene generator stock; and they gloried in their pity. The company spent considerable time in developing its generators; but when they were ready for the market the price of carbide was still far from the prophecies of the promoter. Carbide was then selling at retail for 4 cents a pound, and it has since advanced to 4½ cents.

In June of last year the writer was employed by the company to ascertain the merits of its generators, and to make a general comparison of acetylene light with other lights. A fine country house was chosen for making tests of acetylene. First-rate plumbing was done throughout, and fixtures of the very best sort were hung. A part of the gas main was made of glass to expose any deposit that might be made on its inner surface. The main is as clean now as it was when first laid, which speaks well for the cleanliness of the product of the generator. The generator is one that drops its carbide into a tank of water at suitable intervals. The water supply is so excessive that the generator stays cool during operation. The promoter was withheld from guaranteeing that the operation of this generator in this particular house would not cost more than $18 a year, and luckily so; for it costs $56 a year. The plant is so successful, however, that its owner is well pleased with it.

Fortunately for the company, its promoter happened to promote what is now one of the best generators on the market, otherwise the company would have subsided after learning the true state of the art of acetylene lighting. Perhaps the most interesting thing learned from the practical comparison of acetylene light with other lights is the fact that acetylene is a competitor of isolated systems only. Upon learning the truth, the company ceased its endeavors to talk electrical and common gas light out of existence. It is now doing a handsome business in places where light is not obtainable from a public plant.

There is no substantial cause for assuming that carbide is soon going to be retailed for very much less than its present cost. Furthermore, while the care of an acetylene generator is not

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emaciating, it is sufficiently burdensome to demand consideration. It is beyond question that good acetylene light is of a pleasing quality; that it is restful to eyes that are fatigued by other artificial light; that it is from every point of view a thoroughly successful and low-priced light for isolated places. But when one represents that an isolated acetylene system of lighting is better than an electric or a Welsbach gas system from a public supply, one is either charlatanic or unwise.

EASTON, PA., has found municipal ownership of its electric plant more costly than when there was dependence on outside business control, but the press of that city ascribe the failure there to mismanagement.

MISCELLANEOUS

Latest Progress in the Application of Storage Batteries.[1]—I.

BY JOSEPH APPLETON.

IN dealing with this subject to-night I shall endeavor to put before you some data and results from actual practice, showing the present standing of the storage battery in connection with modern engineering practice. It has been my lot to be very closely connected with every storage battery installation of any size that is now in operation in this country, and I will describe the conditions and methods of operation of some of the most interesting of these.

The history of the storage battery in this country is curious, and probably comprises more troubles and trials than any other branch of the electrical industry. I think it will be generally acknowledged that a storage battery "per se" should be one of the most useful adjuncts in every branch of electrical engineering, but the failures that were recorded in the earlier days proved that the storage battery was not then the commercial success those interested would have us believe. Until 1894, the use of storage batteries in this country proved most disastrous to all concerned. The reasons were many, but may be summed up briefly as follows:

1. The batteries were poorly designed.

2. No attention was paid to the mechanical features, the chief idea being to get the greatest capacity for the lightest weight.

3. The batteries were much over-rated, their full capacity being given as their normal working capacity.

In addition to this the storage battery business generally was in an unsatisfactory and weakly condition. Litigation was the principal cause. The fear of protracted and costly lawsuits prevented capital being invested in the business, and frightened prospective users from purchasing storage batteries.

Now, the conditions are very different. You are all familiar with the changes which have been made during the last five years in the commercial end of the business. All the disturbing elements have been removed, and the business has been put on a proper and substantial basis. These results are best seen from the diagram, Fig. 1. The figures for 1898 have not been tabulated ,but they will show that the use of storage batteries is progressing more rapidly than ever:

	Weight of plates alone.
1894	349,000 lbs.
1895	1,112,800 "
1896	2,215,300 "
1897	3,607,300 "

(Or ten times the business of 1894.)

[1]Abstract of paper read before the N. Y. Elec. Society.

The storage battery is entirely different from any other piece of apparatus which is used for supplying electrical energy, being constructed and operated on the principle of chemical action, instead of mechanical motion. There must, naturally, be a vast difference between these two principles.

In the mechanically operated apparatus, or generator, the output of electrical energy is the result of the conversion of the mechanical energy applied to it while in action, and the regularity of the output is dependent on the steadiness of the mechanical energy applied, and the satisfactory running of the generator and motive power. The operation is purely mechanical, and is subject to the interruptions to which all moving machinery is liable. Again, such apparatus, if overloaded to an excessive degree, will give visible signs of distress, and, if the overloading is very great, or is continued, will probably give way in some mechanical feature.

In a storage battery hundreds of horse power can be silently stored, and thousands of horse power delivered for a short period, with no apparent action or change in the battery. The action is purely chemical, and as long as the respective elements are there to be acted upon it will surely continue.

It is this fact that makes the storage battery so reliable. Such a thing as instantaneous failure or interruption of the delivery of energy is impossible, except, of course, in the case of mechanical injury to the battery from an external cause. Any mechanically operated apparatus is liable to interruption through breakage or injury to one of its parts, but in a storage battery the chemical action will continue, and consequently the output of energy until all the material on the plates has been converted.

An overload has not the same effect on a storage battery as on a mechanically operated generator. For a short period an overload, even of great extent, does not injure a storage battery. It causes the chemical action to take place more rapidly, or, to be more exact, causes more material to be subjected to the chemical action, and this, if not continued too long, or repeated too often, does not affect a good storage battery. Moreover, if the overload is continued too long, it does not mean the sudden failure and collapse of the battery and complete interruption of the output, but is shown by the premature depreciation of the plates in the battery. It may not be noticed for months or even years.

One of the most valuable features of a storage battery is that it will safely take care of any sudden and momentary overload in the system, such as grounds or short circuits, and if operating in parallel with generators or rotary converters, will relieve them of such overloads and consequent strain. I have frequently seen batteries burn out grounds on an underground system, discharging for a short time at an enormous rate. And in the case of batteries operating on railway loads, it is a common thing to see an occasional momentary discharge at a rate equal to twice the hour rate of the battery. The modern storage battery is designed to stand such occasional extreme discharges, and do so without injury.

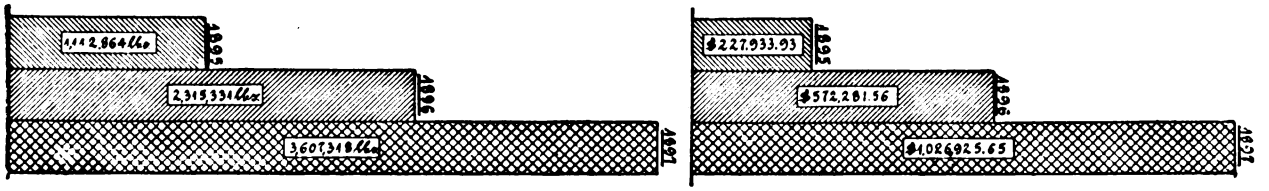

FIG. 1—STORAGE BATTERY OUTPUT AND SALES DURING THE YEARS 1895, '96, AND '97.

It may be well to consider before going further into our subject the question of the rates of charge and discharge of storage batteries, and their capacity at different rates. Of course, this will vary somewhat with different types of battery, but not to a great extent. The more rapidly you discharge a battery the smaller is its available capacity. For example, in Fig. 2, the curve illustrates the available capacity of a storage battery when discharging at any rate between the ten-hour and one-hour rate. That is to say, when the battery is completely discharged in ten hours and in one hour. It is only within the last few years that a one-hour discharge rate has been possible with a storage battery, and it is very largely due to the fact that storage batteries can be discharged at such rapid rates that their use has been growing so rapidly.

In large engineering problems the storage battery is used chiefly to supply large amounts of electrical energy for short

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periods, and by increasing the allowable rate of discharge the size of the battery required is consequently reduced. In connection with this question of the reduced capacity of storage batteries at rapid rates of discharge, there is frequently a mistaken idea that if the capacity of a battery is thus reduced, the efficiency is correspondingly impaired. This is not so at all. It is only the available capacity of the battery which is reduced by polarization, or, in other words, the chemical action when taking place at such rapid rates can only reach the active material which is on the surface of the plates and immediately exposed to the electrolyte. Hence, in reality, the actual capacity of the battery is not reduced, only the available capacity, and when the battery is recharged, only the active material that is acted upon has to be converted and not the entire amount of active material. There is a slightly greater loss in efficiency when discharging at a rapid rate due to the internal resistance of the battery, this being the C^2R loss.

Storage batteries are not free from trouble, any more than any other apparatus, but, under favorable conditions, the comparison is much in favor of the storage battery. No piece of apparatus yet made is perfect, and its usefulness and consequent general adoption may be said to be proportional to the predominance of its useful features, to its weaknesses or troubles. The rapid growth in the use of the storage battery during the last few years is the best proof possible that its troubles are very small compared to its advantages.

As is the case with all machinery and apparatus which have to be operated continually for any length of time, the results obtained depend not entirely on the design and construction, but on the care and judgment with which it is operated. This fact is particularly noticeable to any one who is constantly brought into contact with different plants and installations, as I am, and under different management, or sometimes mismanagement, in all parts of the country, and this subject alone would afford a very interesting and profitable topic for discussion and consideration.

In the early days the storage battery manufacturers, in order to maintain a bare existence, had to jump at every opening for the use of a storage battery, whether the conditions warranted it or not, and, in order to do business, accepted contracts drawn entirely from the purchaser's point of view, without regard to the capabilities of the storage battery, and guaranteed results, which, to say the least, were extremely difficult to realize. What the results of all this was you know very well.

Now, things are entirely different. The business is on a commercial basis, and it is not a question of getting an order at any price, but securing business which will prove satisfactory and permanent. Now, storage battery manufacturers will insist on proper conditions for the operation of their batteries, or refuse to put them in. This is as it should be, and I think I am perfectly safe in saying that during the last four or five years there has not been a storage battery installed in this country, except under conditions which justified its use. Of course some experimental applications have been made which may or may not prove satisfactory, but this does not come under the head of the general application of the storage battery.

It should be distinctly understood that all conditions of electrical distribution are not suitable for the use of storage batteries, and that it is more to the interest of the manufacturer than the purchaser to confine himself only to those situations which are suitable, for every failure which is recorded is heard of one hundred times to every success.

Now, that by this method of doing business, confidence in storage batteries is being regained, and proper relations have been established between manufacturers and users, the growth of the use of storage batteries will be still more rapid, for it is now realized that when storage batteries are installed and operated under proper conditions the result will invariably be satisfactory.

The trend of electrical engineering is to-day toward the concentration of generating machinery, the highest possible economy in operation, and the utilization of motive power and generating machinery to the fullest extent, so that the investment may produce the greatest return. These conditions make the storage battery indispensable, for without its aid it is impossible to maintain a constant load on the power house.

Every application of electricity has its time of maximum output or "peak," and no matter how many different applications are supplied from the same system, their peaks will not fit in so as to even matters up, but, on the contrary, it is found that in many cases the peaks occur at about the same time. This is particularly noticeable with a railroad and lighting load. Again, concentration of generating machinery means a much larger area for distribution, and the necessity of sub-stations, in order to keep down the investment in conductors, and experience shows that in the majority of cases storage batteries are cheaper than the copper alone, which would otherwise be necessary, leaving out the advantages at the power house. This means that the storage battery will now play a most important part in all electrical problems, and be of sufficient importance and value to warrant the conditions being made suitable for its use instead of, as in early days, being dumped in at any time to fill up a gap and smooth over any difficulties which cropped up.

In Europe storage batteries are not subjected to the severe work they have to stand here. They are looked upon more as a reserve, and are not expected to discharge at their maximum rate every day, and, perhaps, twice on some days.

As an example of this, I will tell you what one of the Tudor

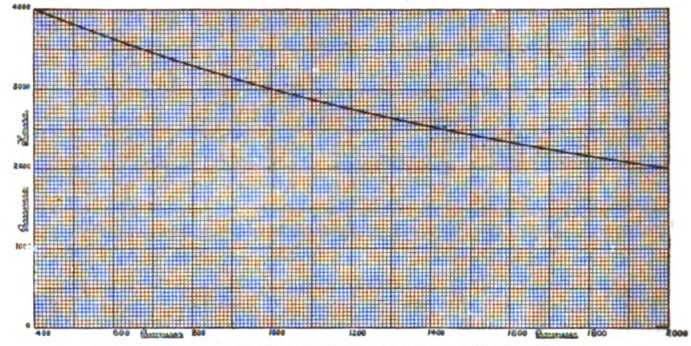

FIG. 2.—CAPACITY CURVE FOR A "29 H" CELL.

Company experts from Germany said when he was over here last spring. He was attending the National Electric Light Convention at Chicago, and one of the features of that convention was the large storage battery plant, which the Chicago Edison had recently installed. During one afternoon, while the convention was being held, a very heavy thunder storm came on, and the battery was called upon suddenly for its maximum rate of discharge, and the full rated capacity was taken out. The maximum rating of this battery was a complete discharge in one hour. Our German friend thought that was doing pretty well, but, when I told him that this storage battery was installed under contract, which allowed the battery to be discharged at this rate every day during the winter, he was horrified and said:

"You must not let them work the battery in that way; tell them they must hold it as reserve." We told him that if we did that we should not be able to do any business, and that we simply had to meet these conditions, and could do so without any difficulty. This instance will show why batteries are maintained at a lower figure in Europe than here, and why it has been customary to refer to the behavior of the battery in Europe. It is a fact that we have now in this country many storage battery installations which surpass anything in Europe, both in size and method of operation.

Application of the Electric Motor to Printing Press Machinery.

MR. W. H. TAPLEY, of the U. S. Government Printing Office, Washington, D. C., read a paper before the Electrical Section of the Franklin Institute, at its stated meeting of Tuesday, January 24, on the above named subject.

There are no statistics, he said, giving the aggregate horse power now used for this purpose, yet it is safe to assert that no one branch of machinery can show the results, in power saved, improved product and increased output from the application of the electric motor, as printing machinery. The printer demands that all the good features of the belt drive as to power and convenience of handling, be retained when the individual electric motor is substituted for belt power. That nothing be sacrificed in economy of operation and completeness of outfit, it is necessary that care be exercised in the selection of the type of motor, method of control and attachment. If this is to be done, the first step consists in becoming familiar with printing press work, studying closely the mechanical features of the press to be equipped; then, and not until then, are we ready to take up the

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electrical end. Of the series, shunt and compound motors, the latter gives the most satisfactory results. Belted, geared and direct connected motors, can be used, though only geared and direct are distinctly advantageous over belting from main line shafting. The selection as to which is better, must be decided in each individual case. Control of press must be positive as to handling under all conditions and providing a suitable range of speed. Where possible, arrange presses to operate at a uniform rate of speed, doing away with the demand for wide extremes, which are rarely used.

Of the various methods of control for direct motors, a combination of armature and field control is best. Armature control with carefully proportioned gearing, in sizes up to 5 h. p., is a dangerous rival of direct motors. All individual motors should be so attached to frame of press as to be practically part of it; separate motor foundations are a failure. Geared motors should be supplied with rawhide pinions having brass sleeve and sides, always using single reduction. Ratios of 10-1 are permissible where press speed is not over 120 r. p. m.; 5 and 3 to 1 where speed is 175 r. p. m., and upward.

Direct motors should be used where noise is an objection, as well as on all large presses, especially for newspaper work. Each equipment should be provided with an automatic circuit breaker, one that will protect press while looking after the motor. This is an absolute necessity if we obtain all the advantages of the individual drive. The cost of direct versus geared press equipment, for new presses, is 25 to 33⅓ per cent. more for the former. Where old belted presses are to be changed with conditions equal, the cost is about the same; the gearing with fixtures amounting to difference in cost between motors. This applies to 5 h. p. motors and larger; smaller sizes may cost very much more, sometimes double.

The general advantages secured by substituting individual electric drive for belting, are economy of power, positive speed applied direct to main driving shaft of press, ability to locate press without reference to main line of shafting, freedom from dust and dirt, higher grade work and increased output, which should amount to 15 per cent. without extra wear on machinery. This will easily pay for the electric equipment within three to five years. As a reliable method of power application, the electric motor is without an equal, for when properly designed as to its work, supplemented with substantial attachment, the repairs are practically nil.

With flat bed presses, printing 32 pages 16mo per impression, an average product can be secured, including all allowances for "make-ready" and handling paper, of 21,000 pages per kilowatt-hour, with price 5c. per k. w. h., 4,200 pages can be printed for 1c. Web presses doing the same class, size and grade of book work, will print, cut and fold 91,000 pages per kilowatt hour, taking same price, 18,000 pages are printed for 1c. A comparison shows a balance of 4½ times in favor of the web presses. When large number of presses are in use, a safe ratio of 5½ to 1 can be as horse power in motors to horse power in generators installed.

Exports of Electrical Material from New York.

The following exports of electrical material and machinery are from the port of New York for the week ending Jan. 24: Antwerp—34 packages electrical material, $3,494. Africa—7 cases electrical material, $604. Argentine Republic—210 cases electrical material, $8,661. British East Indies—4 cases electrical material, $340. Bremen—2 cases electrical material, $886. British possessions in Africa—14 cases electrical material, $383. British West Indies—49 cases electrical material, $14,415. British Australia—2 packages electrical material, $134. Brazil—25 cases electrical material, $907; 66 packages electrical machinery, $1,905. China—1 case electrical material, $53. Cuba—19 packages electrical material, $504. Central America—7 packages electrical material, $246. Copenhagen—8 cases electric motors, $403. Dublin—4 cases electrical material, $236. Genoa—7 cases electrical material, $1,520. Japan—10 cases electrical material, $582. London—68 packages electrical material, $2,594; 17 packages electrical machinery, $1,940. Mexico—26 packages electrical material, $478. Milan—2 cases electrical material, $213. Newfoundland—7 packages electrical material, $641. Oporto—6 cases electrical machinery, $375. Porto Rico—28 packages electrical material, $511. Sandwich Islands—13 cases electrical material, $79. St. Petersburg—26 packages electrical machinery, $5,041. United States of Colombia—97 packages electrical material, $2,500. Uruguay—3 cases electrical material, $121.

Hours of Lighting for February.

In response to inquiries as to hours of lighting we give below a moonlight schedule totaling 184.40 hours:

Day of Week.	Date.	Light.	Extinguish.	Day of Week.	Date.	Light.	Extinguish.
Wed.	1	5.50 PM	12.20 AM	Wed.	15	11.10 NM	5.50 AM
Thu.	2	5.50	1.30	Thu.	16	12.10*	5.50
Fri.	3	5.50 LQ	2.40	Fri.	17	1.10	5.50
Sat.	4	5.50	3.40	Sat.	18	2.00	5.50
Sun.	5	6.00	4.50	Sun.	19	2.40	5.50
Mon.	6	6.00	6.00	Mon.	20	3.20	5.50
Tues.	7	6.00	6.00	Tues.	21	4 00	5.50
Wed.	8	6.00	6.00	Wed.	22	4.30	5.50
Thu.	9	6.00 NM	6.00	Thu.	23	4.50	5.50
Fri.	10	6.00	6.00	Fri.	24	No L.	No L.
Sat.	11	6.00	6.00	Sat.	25	No L. FM	No L.
Sun.	12	6.00	5.50	Sun.	26	No L.	No L.
Mon.	13	6.00	5.50	Mon.	27	6.20 PM	9.10 PM
Tues.	14	10.00	5.50	Tues.	28	6.20	10.20

*AM FQ.

Lighter Storage Batteries.

The lessening of the weight of an accumulator of given capacity is also a problem to be worked at. Gülcher has made an important advance in this direction. He makes his plates of a sort of fabric, the warp being of lead wire and the weft of glass wool. The finely divided active mass adheres firmly to this, and the finished plates are cased in glass wool, which insulates them and lessens the risk of disintegration from mechanical causes, without impending too much the circulation of the liquid. This accumulator has not more than one-third to one-half the weight of an ordinary cell of equal capacity.

Can. Pacific Branch Sold to Street Railway.

A special despatch from Montreal of Jan. 27 says: "The Canadian Pacific Railway line from Hull to Aylmer, in this province, about 7½ miles, which has been leased by the Hull Electric Railway Co. for the last two years at $5,000 per annum, has, it is said, been purchased by the Hull Company for $100,000."

The C. P. R. has been using electric locomotives on this branch as described some time ago in The Electrical Engineer.

A. B. Johnson.

It is with extreme regret that we note the sudden and accidental death at Greenwich, Conn., of Mr. A. B. Johnson, father of Mr. E. H. Johnson, of the Sprague Electric Co., on Sunday, Jan. 29. He left his home at Alta Crest shortly before ten o'clock a. m., seated in a light runabout drawn by a sorrel horse. It was zero weather, and the animal was remarkably lively. Only an hour later neighbors carried his lifeless body back into the house. A friend saw the wagon overturned from a distance and ran to the scene. He obtained help, and placed Mr. Johnson in a carriage and took him to his home, only a short distance away. Various reasons are given for the accident. One is that part of the harness gave way, and that Mr. Johnson thus lost control of the animal. Mr. E. H. Johnson was summoned by telephone from New York at once. He was expected to arrive in Greenwich on the ten o'clock morning train, and his father had gone to the station to meet him, but was disappointed.

The body has been taken to Philadelphia for interment. Mr. Johnson, although just upon 80, was a masterful horseman, and usually able to give a good report of any of the spirited creatures kept at his son's adjoining country seat. He was well known in electrical circles through the members of his family, to whom universal sympathy is extended in this painful bereavement.

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Classified Digest of U. S. Electrical Patents Issued Jan. 17, 1899.

Alarms and Signals:—

ELECTRIC SIGNALING. John Pressley Coleman, Edgewood Park, Pa., assignor to the Union Switch and Signal Co., Swissvale, Pa., 617,853. Filed Dec. 2, 1897. Relates to improvements in relays for controlling circuits operating translating devices whereby they may be rendered inoperative in case of the de-energizing of the relay magnets, although the contact points in the circuit controlled may be fused together.

RELAY. John Pressley Coleman, Edgewood Park, Pa., assignor to the Union Switch and Signal Co., Swissvale, Pa., 617,854. Filed Jan. 20, 1898. The combination of a magnet, an armature, contact plates, pivotally mounted on the armature, a binding screw, a bar secured to the binding screw, and a screw passing through the bar and forming a back contact for the contact plates.

Batteries Secondary:—

GALVANIC BATTERY. Charles T. Richmond, Cleveland, O., assignor to the National Carbon Co., Cleveland, O., 617,908. Filed July 18, 1898. The combination of parts constituting a single cell and the combination of two or more cells within a single containing vessel.

GALVANIC BATTERY. James D. Darling, Philadelphia, Pa., assignor to the Harrison Bros. & Co., incorporated, Philadelphia, Pa., 618,042. Filed Oct. 16, 1897. Both elements are disposed in a horizontal direction, the zinc element being of little vertical height and of such breadth as to make a close fit with the walls.

ZINC ELECTRODE. James D. Darling, Philadelphia, Pa., assignor to the Harrison Bros. & Co., Incorporated, Philadelphia, Pa., 618,043. Filed Aug. 17, 1898. Comprises a cup-shaped zinc electrode having a mass of solid zinc amalgam therein.

Conductors, Conduits and Insulators:—

ANCHOR FOR OVERHEAD WIRES. John George Buehler, New York, N. Y., assignor to Columbia Machine Co., New York, N. Y., 617,804. Filed Sept. 1, 1898. Comprises a double pull-over, a line ear connected to it, a side piece connected to the line ear, the ends of the side piece being off-set and means on the pull-over and side piece for attaching the stay-wires.

ELECTRICAL ALARM MATTING. Arthur de Forest Risley, Richfield Springs, N. Y., 617,938. Filed Jan. 27, 1898. An elastic non-conducting fabric provided with aligned orifices, parallel conducting strips arranged above and below the orifices and forming the insulated terminals and a loose conductor caged within the orifice.

Distribution:—

METHOD OF AND MEANS FOR DERIVING POLYPHASE CURRENTS. Herbert A. Wagner, St. Louis, Mo., 617,842. Filed Nov. 13, 1896. Consists in connecting the branch circuits to different points in a single-phase supply circuit and to each other, and shifting the phase of one of the branch circuits. See page 133.

Electro-Metallurgy:—

ELECTROLYTIC REFINING OF COPPER. Elias A. Smith, Anaconda, Mont., 617,886. Filed May 19, 1898. Consists in depositing the copper from anodes thereof immersed in an acid bath, concentrating the resultant impure electrolyte to recover by crystallization the bulk of the blue vitriol; further treating the "mother liquor" by progressive shallow evaporation at high temperature under air pressure, to throw down the iron salts and further treating it for the antimony and arsenic.

METHOD OF EXTRACTING METALLIC ORES. Elias Anthon Smith and Markus Hartmann Lyng, Anaconda, Mont., 617,911. Filed Nov. 17, 1897. Consists in digesting the wet pulverized ore under heat and pressure by means of a suitable oxidizing agent in presence of a free acid and thereafter separating the soluble salts from the refuse gangue.

Measurements:—

COUNTING MECHANISM OF ELECTRIC SUPPLY MOTOR METERS. Sydney Evershed, London, England, 617,726. Filed June 7, 1898. Details of construction.

Miscellaneous:—

ELECTRIC CONDENSER. Charles S. Bradley, Avon, N. Y., 617,714. Filed Dec. 16, 1897. Composed of wires wound adjacent to one another and kept from electric contact by an open spiral of insulating material wound about one of them. See page 134.

APPARATUS FOR PRODUCING ELECTRIC CURRENTS. Mitford C. Massie, Washington, D. C., 617,901. Filed Oct. 11, 1898. A Wheatstone bridge is combined with means for repeatedly and alternately balancing and unbalancing the resistance of its branches and means for energizing the branches whereby a current is produced in the bridge conductor.

ELECTRICAL APPARATUS FOR FREEING, LIGHTING OR EXTINGUISHING GAS BURNERS AT A DISTANCE. Paul Louis Guyenot, Aix Les Bains, France, 617,958. Filed July 30, 1898. Employs a ball valve which is operated by an electromagnet.

METHOD OF MANUFACTURING GRAPHITE ARTICLES. Edward Goodrich Acheson, Buffalo, N. Y., 617,979. Filed Nov. 3, 1898. The raw material is taken in proper quantity, is molded under pressure in the shape of the article, and is then converted into graphite. See page 132.

ELECTROMAGNET. Max Schiemann, Dresden, Germany, 617,838. filed Dec. 31, 1897. Adapted for use as a circuit closer on electric railways in which a sectional conductor rail is used.

ELECTRIC IGNITER FOR EXPLOSIVE ENGINES. F. E. Canda, New York, 617,806. Filed Aug. 26, 1897. Details of construction.

ELECTROMAGNETIC HONE. Theo. R. Smith, Los Angeles, Cal., 617,783. Filed Dec. 9, 1897. Details of construction.

Railways and Appliances:—

CONDUIT ELECTRIC RAILWAY. Richard W. Barkley, New York, 617,708. Filed June 13, 1892. Renewed Jan. 22, 1895. Comprises a main conductor, a double trolley provided with two contact pieces, independent conductors from the pieces and means for causing either of the pieces to make contact with the main conductor.

MEANS FOR BONDING RAILWAY RAILS. Frederick Hachmann, Milwaukee, Wis., assignor of thirty-one fortieths to M. F. Elisabeth Baasen and Henry L. Strohmeyer, Milwaukee, Wis., 617,737. Filed Sept. 14, 1898. Consists of an integral metal bar and legs thereon, one at each extremity of the bar projecting in the same direction, the legs having laterally projecting toes on corresponding sides of the legs.

ELECTRIC RAILWAY SYSTEM. Emil Berthold Walter Reichel, Berlin, Germany, assignor to the Siemens & Halske Electric Co., of America, Chicago, Ill., 617,837. Filed Oct. 3, 1898. An indicator for guiding the assistant motorman on a train containing more than one motor car.

Regulators:—

REGULATOR FOR CONSTANT CURRENT DYNAMOS. James J. Wood, Fort Wayne, Ind., 617,793. Filed July 8, 1898. Designed for use on an arc dynamo feeding a circuit of lamps in series.

Switches, Cut-Outs etc,:—

ENCLOSED ELECTRIC SWITCH. William Milton Brown, Johnstown, Pa., 617,715. Filed Sept. 11, 1897. Comprises a closed insulating vessel and a casing for same, tapered passages in the opposite walls of the vessel and casing, a post passing through the vessel and fitting in the bearings and a switch member carried by the central portion of the post.

FUSE PLUG. Leslie C. Orrell, Chicago, Ill., 617,765. Filed Sept. 25, 1897. Constructed so as to be easily renewable.

Telegraphs:—

TELAUTOGRAPH. George S. Tiffany, Highland Park, Ill., assignor to the Gray National Telautograph Co., Richmond, Va., 617,890. Filed May 29, 1896. Renewed Feb. 11, 1898. Details of construction.

TELAUTOGRAPH. George S. Tiffany, Highland Park, Ill., assignor to the Gray National Telautograph Co., Richmond, Va., 617,891. Filed Feb. 8, 1897. Renewed July 20, 1898. Details of construction.

TELAUTOGRAPH. George S. Tiffany, Highland Park, Ill., assignor to the Gray National Telautograph Co., Richmond, Va., 617,892. Filed Aug. 21, 1897. Renewed July 29, 1898. Details of construction.

Telephones:—

CONNECTION-COUNTING MECHANISM FOR TELEPHONE LINES. Charles E. Scribner, Chicago, Ill., assignor to the Western Electric Co., Chicago, Ill., 617,839. Filed March 15, 1897. Details of construction.

LOCK-OUT MECHANISM FOR PARTY TELEPHONE LINES. Charles E. Scribner, Chicago, Ill., assignor to the Western Electric Co., Chicago, Ill., 617,840. Filed June 21, 1897. Details of construction.

MAGNETO CIRCUIT CLOSER. John E. Fuller, New York, N. Y., assignor to Caleb Coles Dusenbury, Lake Mahopac, N. Y., 617,858. Filed Nov. 10, 1898. A switch is actuated automatically by the current set up in the generator so as to include in the exterior circuit the circuit passing through the coils of the armature.

Walker Motor Not an Infringement.

It was decided in the United States Circuit Court of Appeals at Boston on Jan. 26, Judges Colt, Webb and Brown, in the case of the Thomson-Houston Electric Co. vs. the Athol & Orange Street Railway Company, that the Walker motor which is in use by the company is not an infringement of patent No. 448,260, issued March 17, 1891, to Edwin W. Rice, Jr. The bill therefore is dismissed, the court, whose opinion is written by Judge Colt, holding "that in construction and mode of operation the Walker motor is distinctly different from that described in the Rice patent."

Edison Elec. Lt. Co., N. Y. vs. E. G. Bernard & Co., Dismissed—Life Too Short for Such Cases.

In rendering a decision in the case of the Edison Electric Light Co. against the E. G. Bernard Co. et al., an infringement case that has been in the United States Courts for a long time, Judge Coxe says: "The defendants' counsel, in the memorandum submitted upon this motion, have exhausted the list of adjectives belonging to legal nomenclature in expressing their opinion of the absolutely untenable character of the complainant's case. In their opinion the greater part of the complainant's testimony was 'irrelevant,' its case 'hopeless,' the suit 'unjust' and the complainant's conduct in maintaining it 'a wilful and malicious tool.' To the extent of holding that the action cannot be maintained the court agrees with them. The court is also of the opinion that a volume two and one-fourth inches in thickness and containing nearly 1,000 printed pages was unnecessary to meet such a cause of action."

After reviewing the evidence and argument and dismissing the bill with three-fourths of the costs on complainant, Judge Coxe

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says: "In brief it is thought that no impartial mind can examine this record, in the light of the simple issue involved, without being convinced that it is an imposition upon court, counsel and parties alike. Such words obstruct the paths of truth, retard equity and tend to shorten life and to promote insanity. If the bar would unite with the bench in confining the records in equity causes within reasonable limits, it is thought that the reform would be even more advantageous to the former than the latter."

Nassau Railroad Fined for Refusal to Obey an Injunction.

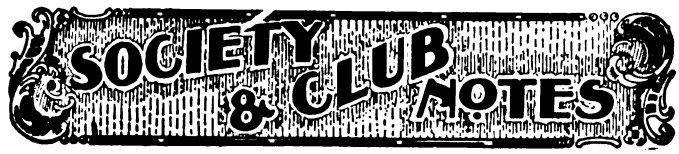
United States Judge Lacomb filed in the office of the clerk of the United States Circuit Court, in Brooklyn, last week a finding in the case against the Nassau Electric Railroad Company, in which the latter is fined $25 each on several hundred cars for neglecting to observe an injunction issued on the petition of the Sprague Company for infringement of patents in the operation of car motors. The arguments were heard by Judge Lacomb several months ago, during which time the Nassau Company, it is stated, continued to use the patent, and the findings are accompanied by a second injunction issued in favor of the Sprague patents by the General Electric Company.

Telegraph Companies' Rights on Railways.

The Supreme Court of Appeals of Virginia at Richmond, Va., on Jan. 27 rendered an important decision in the case of the Postal Telegraph Co. against the Farmville and Powhatan Railway. The Court reversed the decision of the former court in the case of the telegraph company against the Norfolk and Western. The effect of the decision is to give the Postal the right of condemnation proceedings along all railway rights of way.

Telephone Summons Held Legal.

A special despatch from Hillsboro, Tex., of January 17, says: The fine of $100 imposed upon Sheriff Anderson, of Harris County, for a failure to make a return on an instanter subpoena in the Erwin habeas corpus at Dallas recalls the Hawk habeas corpus in this county recently. The point in each case, that a summons by telephone is legal, is the same. Judge Morrow so ruled on the point, and fined Hawk, the city marshal of Corsicana, $50 for failure to obey a telephone subpoena, but afterward reduced it to $15, and it was paid. The case of Sheriff Anderson is being watched here with interest.



American Institute of Electrical Engineers.

The 131st meeting of the Institute was held at 12 West Thirty-first street Wednesday evening, January 25. An interesting and valuable paper was presented by Lieut. S. Dana Greene, of Schenectady, entitled "Electricity on Ship Board," illustrated by diagrams. It was discussed by Capt. Millis, Lieut. Walling, J. W. Lieb, Jr., T. C. Martin, Prof. Elihu Thomson, Townsend Wolcott and others.

At the meeting of the Executive Committee in the afternoon the following associate members were elected: Royal Bradford Daggett, electrical engineer, Electric Storage Battery Co., Marquette Building, Chicago, Ill. Ernest I. Dyer, engineer and manager of the Engineering Department of the American Trading Co., Box 28, Yokohama, Japan. George Henry Hill, chief engineer, Elevator Department, Sprague Electric Co., Bloomfield, N. J.; residence, New York City. Ernest Rowland Hill, electrical engineer, Westinghouse E. & M. Co., Pittsburg, Pa. William A. Lynn, assistant in electrical engineering, University of California, Berkeley, Cal. J. Manley Simpson, assistant superintendent, Northwestern Grass Twine Co., P. O. Box 2513, St. Paul, Minn. Thomas Perrin Thompson, electrical laboratorian, Brooklyn Navy Yard; residence, 217 Cumberland street, Brooklyn, N. Y. Alfred J. Thompson, electrical engineer and contractor, San Ignacio 50, Havana, Cuba. Robert M. Wilson, student, McGill University; residence, 113 Shuter street, Montreal, Quebec.

The following were transferred to full membership: Philander Betts, electrician, U. S. Navy Yard, Washington, D. C. Winden Elwell Goldsborough, professor of electrical engineering, Purdue University, Lafayette, Ind.

National Association of Manufacturers.

The above association held last week a very interesting, well attended and satisfactory meeting at Cincinnati, where many hospitalities were extended. The papers and discussions occupied several days and were devoted to questions of commerce and trade, patents and copyrights, etc. Commissioner Peck, of the Paris Exposition, appeared before the convention, and his advocacy of a fine representation for America was warmly endorsed. The meeting for 1899 is to be held in Boston. The officers elected for the ensuing year are: President, Theodore C. Search, of Philadelphia; secretary, E. P. Wilson, of Cincinnati; treasurer, Charles A. Schieren, of New York, all the incumbents of the past year. Mr. C. A. Moore is vice-president for New York; Mr. John H. Converse, for Pennsylvania; Mr. Pliny Newell, for Connecticut.

Rising Tide of Trade.

The recent great activity in stocks and bonds has been but an anticipation and discounting of the improvement in the conditions of business, as evidenced by the better quotations for all staples, and the speculative dealings in many lines of product, due to the desire to benefit by the large demands that appear in the returns of consumption on every hand. Iron and steel are in briskest demand, copper is advancing, coal is active, the lumber trade is busy; advances in cotton are maintained, and dry goods are wanted; wool is firm, and machinery is in request everywhere for almost every line. Retail trade is very good throughout the country.

Last week was the busiest that Wall Street has ever seen, due in some measure to a healthy reaction which has checked the fever to buy anything in sight. Sales even ran up to 1,600,000 shares in a day, but on the whole the market was very steady, and money continued easy. During the week, 95,640 shares of Western Union exchanged hands around 96 to 98, while General Electric on sales of 27,172 soared to 112⅞ and closed at 111. Commercial Cable sold at 189. New York Edison was steady at 195-6, but Metropolitan Street Railway made a splendid jump from 196 to 217 on sales of 84,000 shares. In Boston, American Bell fell off 13 points to 300, but West End was strong at 94.

Copper, New York, sold at 15.75 cents; tin at 24.50; heavy steel rail, Eastern mill, $19. All the metal markets are buoyant.

Brooklyn, N. Y., Railroad Consolidation.

A syndicate, headed by ex-Governor Roswell P. Flower and his associates in the Brooklyn Rapid Transit Co., has been formed for the purpose of bringing about the consolidation of the local transportation companies. In addition to the more than three hundred and fifty miles of double tracks controlled by the Rapid Transit and Nassau systems, the other companies to be taken into the consolidation are the Coney Island and Brooklyn (which in turn owns the Brooklyn City and Newtown), the Brooklyn Elevated and the Kings County Elevated.

The total mileage of the combined surface roads to be operated by the syndicate amounts to over 650 miles, the Brooklyn Heights system consisting of 205, the Brooklyn, Queens County and Suburban, 45; the Brooklyn City and Newtown, 19; the

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Coney Island and Brooklyn, 25, and the Nassau electric system, 135.

The gross earnings of the roads in 1898 amounted to $9,903,150, $4,726,142 being earned by the Brooklyn Heights system, $1,626,423 by the Queens County and Suburban, $700,924 by the Brooklyn City and Newtown, $694,480 by the Coney Island and Brooklyn.

The mileage of the elevated roads amounts to about 27, of which the Brooklyn Union has about 18 miles and the Kings County Elevated, 9.

Am. Dist. Tel. of N. Y.

The report of the American District Telegraph Co., of New York City, for the year ended Dec. 31, shows: Gross earnings, $568,156, an increase of $37,814; net earnings, $86,649, an increase of $14,736; total income, $104,514, an increase of $14,814; construction, $13,178, a decrease of $1,333; balance, $91,336, an increase of $16,147; surplus, after dividends, $14,452, an increase of $16,145; damages settled, $5,000, an increase of $5,000; surplus, $9,452, an increase of $11,145; previous surplus, $53,020, a decrease of $1,693; total surplus, $62,472, an increase of $9,452.

TRADE NOTES AND NOVELTIES

The Harrison Open Circuit Cell.

OTHER things being equal, the great desiratum in a voltaic cell is high e. m. f. At the present time the cells in commercial practice giving the highest potentials are those employing bichromate of potash in one form or another as a depolarizer. Even with this electrolyte and employing carbon and zinc as the elements an e. m. f. of 2 volts can scarcely be counted on in regular work. It will be of interest, therefore, to many engaged in electrical work to learn that a cell is now available giving close on to 2.5 volts, which is specially adapted to open circuit and what may be termed semi-open circuit work.

HARRISON OPEN CIRCUIT CELL.

The cell, which is illustrated in the accompanying engraving, is endowed with its high e. m. f. by the use of zinc as the positive element, and peroxide of lead as the negative. Peroxide of lead, as is well known, is the active material of the storage battery. Peroxide of lead is highly electro-negative, and hence, by placing it in juxtaposition to zinc, the high voltage of nearly 2.45 volts per cell is obtained, the electrolyte being dilute sulphuric acid.

In this cell, which is the result of several years' experimentation on the part of the manufacturers, Messrs. Harrison Bros. & Co., Incorp., of Philadelphia, one ounce of zinc will give 20 ampere-hours at an average of 2.2 volts. Theoretically, there is enough lead peroxide in each cell to depolarize three ounces of zinc. This would give a capacity of 60 ampere-hours. In actual practice, with a slow rate of discharge on open circuit work, about two-thirds of the theoretical is possible, or 40 ampere-hours.

In the Harrison cell, one charge of acid will dissolve one ounce of zinc without due increase of internal resistance. Local action does not occur, even when the zinc gets rough, as the zinc is self-amalgamating to the last.

The negative element, as stated above, is made of peroxide of lead, eight ounces of which material is used in the manufacture of one stick. It is estimated that the cost of the electrical energy obtained from this cell is a little over 1 cent per watt-hour.

In a test of these cells, made recently by Mr. Milford Levis, it was shown that after nearly four months' working the e. m. f., originally 2.49 volts, had decreased to only 2.4 volts.

Besides its special adaptation to open circuit work, such as electric bells, burglar alarms, telephone transmitters, etc., the cell is eminently adapted for the operation of physicians' and dentists' miniature lamps, two cells 6 inches high by 4 inches square, being sufficient to light up such lamps to full brilliancy.

This novel and interesting cell is now being placed on the market by the Thermo-Electric Co., "Times" Building, New York, who are the sole agents for its sale.

Triumph Co.'s New Dynamo.

An expression used in our article last week on the new dynamo is open to misconstruction. The saving of power claimed by the manufacturers, the Triumph Electric Co., of Cincinnati, is 35 per cent. In other words, for an equal number of lights maintained, only 65 per cent. of the energy hitherto used, is required by the new machine for its work.

Advance Electric Co.

We are advised by the Advance Electric Co., of Indianapolis, Ind., that the following changes have occurred in its administrative personnel: Mr. D. D. Smith retires as president, and Mr. Harry B. Marsh has been elected to the position. Mr. Charles H. Talmage remains as treasurer, and Mr. Herbert S. Wood, of the Indiana National Bank, is made secretary. The Board of Directors is composed as follows: Messrs. H. B. Marsh, C. H. Talmage, H. S. Wood and J. C. Ingram. The company is engaged in bulk electrical construction, supplies and general repair work in both street railway and power plants, and has been in existence two years.

American Bridge for Hawaii.

The Berlin Iron Bridge Co., at East Berlin, Conn., have just shipped several carloads of bridge material to the Hawaiian Islands. It is believed this is the first American bridge that was ever put up in these islands. The contract for this bridge was obtained through their regular established agency at Honolulu, and the men will be sent from the United States to put up the bridge, which is for highway travel. It consists of one span of 200 feet, 40 feet wide, and will be located across a river in one of the larger towns of the islands.

The Berlin Iron Bridge Co. are doing quite a large foreign business, having a regular established agency at Honolulu, also one at Guadalajara, Mexico and at Berlin, Germany. They also have a representative at the present time traveling through Russia obtaining information in reference to the possibilities of steel buildings for that country. When it is shown that the American bridge builder can furnish steel structural work for all of these foreign countries the possibilities of the business are of such a nature that one can readily understand the large advance that has been made in the economical production of this class of material by American mechanics in the last twenty years.

EARL W. SLAWSON, as trustee, has bought the factory, etc., of the old National Electric Co., and is forming a new concern to be known as the Phoenix Manufacturing Company, in which J. H. Roberts, T. Hobbs and others will be interested with him. The plant will be started up, and 50 men employed at the outset.

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Guest Calls and Fire Alarms.

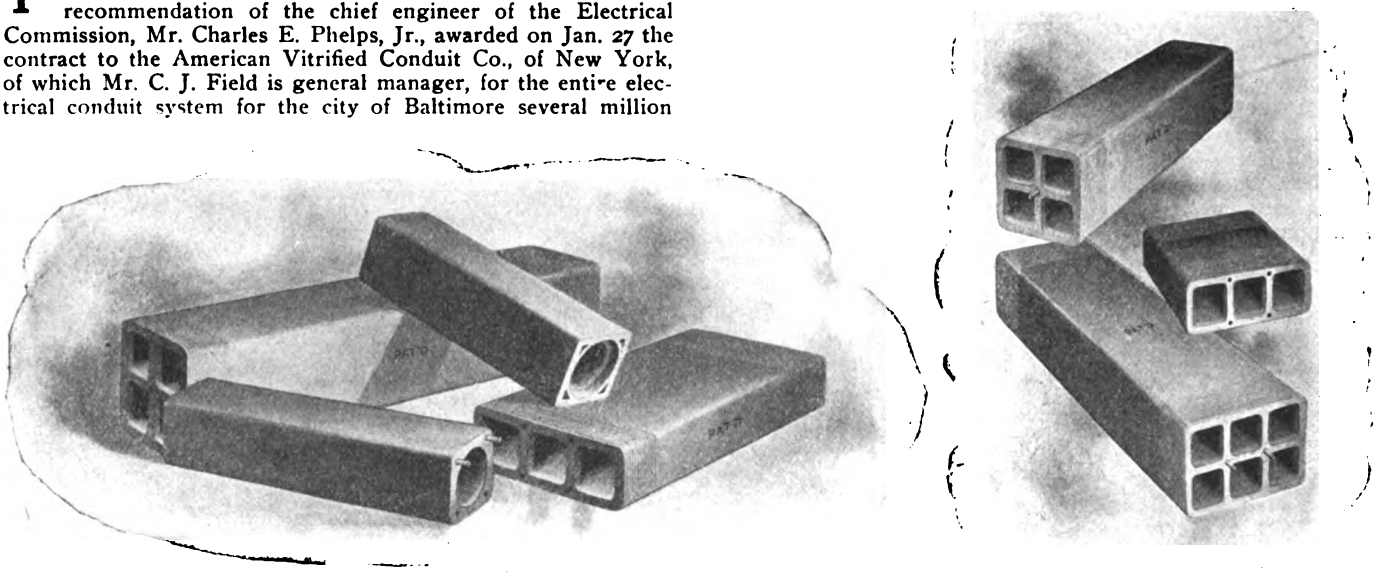
The electrical industry in the line of annunciators has enjoyed many promising points of promotion during the past few years in the line of guest call and fire-alarm attachments, which are universally used throughout the country in all the larger and most modern hotels. Among the most recent features is the telephone system, which is now being used in a great many hotels in connection with their annunciator.

This enables the clerk to call the occupant of the room, and by connecting a plug in the spring jack, directly beneath the return call push, he is enabled to carry on a conversation by means of a telephone, which does away entirely with the old system of speaking tube, which was formerly used in a great many instances.

While observing these points of advantage and industry in this line, we might make mention of the fact that the Western Electrical Supply Company, of St. Louis, Mo., have recently incorporated this system into their well known "Perfection" annunciator, and are now in a position to furnish any hotel instrument with or without return call attachment, with the telephone attachment, full particulars of which will be furnished on application.

American Vitrified Conduit Co.'s System In Baltimore.

THE Board of Awards of the city of Baltimore, upon the recommendation of the chief engineer of the Electrical Commission, Mr. Charles E. Phelps, Jr., awarded on Jan. 27 the contract to the American Vitrified Conduit Co., of New York, of which Mr. C. J. Field is general manager, for the entire electrical conduit system for the city of Baltimore several million feet of their vitrified tile multiple duct conduits. The multiple is from two to sixteen ducts.



"AMERICAN VITRIFIED" CONDUITS AS ADOPTED FOR BALTIMORE.

The engineer of the commission, Mr. Phelps, prepared very careful specifications, on which bids were received for the various kinds of multiple and single-duct tile conduits, cement pipe, wooden and indurated fibre. The commission reserved the right to select any style conduit they thought best for the city's interest after opening of bids and upon the recommendation of their chief engineer. Bids were opened on Wednesday, Jan. 25, and referred to the engineer for his report. Upon his recommendation, made after very careful consideration and investigation of the subject, the contract was awarded to the American Vitrified Conduit Co., as above stated, although their bid was among the highest submitted on conduits.

LERCH BROS. STORE, of Baltimore, Md., have recently started up a direct connected outfit, consisting of a General Electric generator direct connected to a 100 h. p. engine, built by the Ball Engine Co., Erie, Pa.

THE CHICAGO FUSE WIRE & MFG. CO., 154 Lake street, Chicago, and 853 Broadway, New York, are offering something interesting in the way of railway fuse links. There seems to be no question as to the quality of goods made by this company.

Baker & Co.

Owing to increased business demands made upon Messrs. Baker & Co., the platinum refiners, to secure additional space, they have found it necessary to remove their New York office from 121 to 120 Liberty street.

They have on exhibition at the above address a number of specimens of crude platinum, among which is their large nugget, which is believed to be the biggest in any collection on the American continent.

The collection is very interesting to metallurgists, chemists and all persons interested in the different uses of platinum.

Warren Elec. Mfg. Co., of Sandusky.

The Warren Electric Manufacturing Company, of Sandusky, O., has appointed J. Holt Gates & Co., 1426 and 1427 Marquette Building, Chicago, general agents for their apparatus in the Western territory surrounding Chicago. They have recently placed, through that concern, a 15,000-light alternating current plant for the great new power and light plant of Armour & Co. at their extensive works at the Union Stock Yards, Chicago. This plant will consist of one machine of 7,000 16-candle power light capacity, at 1,110 volts and 7,200 alternations; also two 3,600 lighters, 1,100 volts and 7,200 alternations. These alternators of the inductor type, will be operated by rope drive from Corliss engines of 2,000 h. p. and 1,100 h. p. each, to which engines will also be attached Walker direct connected power generators. It is stated that the Warren alternators were selected on account of their close regulation, high efficiency, low temperature and ability to stand "grief."

The Warren Electric Co. are now prepared in their new factory to build 10,000-light machines, both single and two-phase. They have sixty odd machines on order at the present time. Their new plant at Sandusky, O., is modern and up-to-date.

In An English Cotton Mill.

A contract has recently been received by the Westinghouse Electric and Manufacturing Company for installing an electrical plant to operate a large cotton mill near Manchester, England. The machinery involved in the contract consists of two alternating current generators and 21 motors, having an aggregate capacity of 310 h. p. The contract was received through the London agency, from Beyer, Peacock & Co., of Manchester, England.

PUERTO RICO, W. I. Articles of incorporation have been filed in New Jersey of the Puerto Rico Co., with an authorized capital of $1,000,000. This company is empowered to manufacture and sell gas and electric light in the West India Islands. The incorporators are Matthew Randall, Nathan J. Mitchell, Edmund C. Alsop and Frank B. McAvoy.

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Simplex Friction Tape in Tin Boxes.

THE Western Electric Company, of Chicago and New York, is furnishing its customers Simplex friction tape packed in tin boxes. The boxes are 4¼ inches in diameter and 1 inch deep, and contain one-half pound rolls of tape carefully wrapped in oil paper. The tape is prepared with the greatest care, of high grade materials, and either white or black tape is furnished.

This method of packing tape has advantages which are readily

appreciated. The tape is thoroughly protected from the drying-out effect due to the exposure to air, and is also protected from dirt. The box is of a convenient size, to be carried by the wireman, and will supply him with a receptacle for the partially used roll which otherwise might be thrown loosely into the tool bag. It is convenient, always clean and economical, and contractors, central station managers and users of tape generally will find it to their advantage to order at least a sample lot.

CATALOGUES.

Manhattan Electrical Supply Co.

This pushing and enterprising concern, of 32 Cortlandt street, New York City, has in its new and handsome catalogue No. 10, of 336 pages, a perfect mine of information as to electric light goods, household electrical apparatus and telegraph and telephone supplies. These are all profusely illustrated, and descriptive data is given with prices. When the company was started in 1888 it had a floor space of 320 square feet. It now has over 60,000 square feet, and its own factory is fully equipped for the cheap production of all classes of goods at the lowest prices compatible with excellence.

Fan versus Chimney.

"Artificial draft," so states Mr. W. S. Hutton, "can be readily adjusted to effect the combustion of different kinds of fuel at different rates of combustion. It permits efficient combustion of fuel of inferior quality, and enables a steady supply of steam to be maintained, independent of climate and weather. It enables the supply of air to be properly distributed to the fuel in the furnace to effect economical combustion. The supply of air above the fuel can be readily adjusted to effect combustion of the gases evolved by the fuel, and the supply of air below the fuel can be regulated to effect the combustion of the solid portion of the fuel, and the movement of the hot gases can be readily controlled."

There is no valuable feature of the chimney that is not possessed by the fan to at least the same, and in many cases to a more marked degree. The very features which are most conducive to economy are those which are incidental to the use of the fan for draft production. While the recent extensive introduction of induced draft in stationary practice has done much to emphasize the advantages of this system, the general superiority of mechanical draft, properly applied, has long been recognized by those who have given careful consideration to the matter. The B. F. Sturtevant Co., Boston, Mass., note the above in a recent pamphlet on the subject.

THE ASHTON VALVE CO., 271 Franklin street, Boston, Mass., have got out a very attractive calendar for 1899. It comprises an 11 x 14 inch card, upon which is a handsome engraving entitled "Chips of the Old Block," and portraying two specimens of "Young America" engaged in playing with miniature steamboat and locomotive. The Ashton Valve Co. manufacture pop safety valves, bearing their name, and also the Ashton pressure and vacuum gauges.

ADVERTISERS' HINTS

THE SAFETY THIRD-RAIL ELECTRIC CO., Temple Court, New York, will shortly issue an invitation to their friends and all others who are interested to visit an installation of their system at Manhattan Beach, N. Y. Later announcement will be made giving date, etc.

THE DEARBORN DRUG AND CHEMICAL CO., Rialto Building, Chicago, remind the public of their method of analyzing samples of boiler water and then preparing a compound to meet the requirements of each special case.

B. W. STANDARD STREET FIXTURES are offered by the Bibber-White Company, 49 Federal street, Boston, Mass. They illustrate their fixture No. 1, which is furnished with porcelain insulators bolted to the fitting, constituting a good, strong fixture.

THE AMERICAN ELECTRICAL HEATER CO., 197 River street, Detroit, Mich., advertise soldering and laundry irons, said to be convenient and economical as well.

THE UNITED ELECTRIC IMPROVEMENT CO., Nineteenth street and Allegheny avenue, Philadelphia, advertise direct and alternating current apparatus for power and lighting. They also call attention to their high grade incandescent lamps.

THE AMERICAN IMPULSE WHEEL CO., 120 Liberty street, New York, publish a testimonial letter from the Scranton Supply and Machinery Company, attesting the excellence of their water wheels.

THE E. W. BLISS CO., Brooklyn, N. Y., illustrate their announcement with a style of armature disc tool built by them, which has been received with great favor.

THE WESTINGHOUSE ELECTRIC AND MFG. CO., Pittsburg, Pa., call attention to the Westinghouse rotary transformers.

WESTERN NOTES

J. HOLT GATES & CO., Marquette Building, Chicago, report the following recent sales: Armour Glue Works, Chicago one 225 k. w. 500 volt generator, two 150 k. w. 500 volt generators; seven 50 h. p. motors, two 100 h. p. motors, two 150 h. p. motors, one 30 h. p. motors, made by the Card Electric Co., Mansfield, O. Deering Harvester Co., Chicago, seven 500-light transformers, five 400-light transformers, three 200-light transformers. Elkhart Lake Electric Light Co., Elkhart Lake, Wis., two 10 h. p. single-phase motors and transformers and direct dynamos, attached to large storage batteries for electric launches. Armour Glue Works, Chicago, one $3,000 switchboard. Pierce & Robinson, Chicago, one $700 switchboard. Residence of P. D. Armour, Jr., Chicago, one 300-light electric light plant, with Nash gas engine direct connected.

THE ELECTRIC APPLIANCE CO. are calling attention to the accessibility of their new location at 92 and 94 West Van Buren street. There is probably not another corner in Chicago that has more transportation lines passing it than the corner of Van Buren and Jefferson streets. Several electrical lines pass the building in addition to the principal cable line of the city, and also the principal elevated road. None of the Electric Appliance Company's friends when in Chicago should fail to visit them in their new location.

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MR. C. W. FARR, president of the Farr Telephone Supply Co., Chicago, reports an enormous demand for their popular priced bridging magneto bells. Mr. Farr states that their business during 1898 was nearly double that of 1897.

FORT WAYNE ELEC. CORPN. Bankruptcy proceedings against the corcern are being pushed by creditors with claims that aggregate $50,000. Its assets are put at $350,000 and its indebtedness at $900,000.

MT. VERNON, IND. This city has let its electric lighting contract to Wm. Gonnerman & Co. for a period of ten years, beginning July, 1899. This company will immediately install a modern plant for both arc and incandescent lighting. Address A. L. Abbott.

MR. W. R. MASON, who was for the last two years local agent at St. Louis for the Walker Co., has been appointed the selling agent for the Siemens & Halske Electric Co., with offices at 314 Security Building, that city.

THE EMERSON ELEC. MFG. CO., of St. Louis, received a few days ago, an order from China for forty-eight fan motors and twenty-four ceiling fans, and on the next day an order for thirty alternating current ceiling fans for shipment to Argentine, S. A. In addition to these orders the demand is unusually active from the larger cities in the United States.

"CLARENCE C. BLACK," the new steamer built by the Cleveland Ship Building Co., Lorain, Ohio, has a very handsome and compact electric plant, consisting of an Elwell-Parker dynamo direct connected to a 30 h. p. engine, built by the Ball Engine Co., Erie, Pa.

MR. GEORGE A. McKINLOCK, president of the Central Electric Co., of Chicago, was a visitor in New York last week, actively interested in plans for his large and growing business.

NEW YORK NOTES.

THE FERRACUTE MACHINE CO., Bridgeton, N. J., has shipped a large press to Joseph Sankey & Sons, Bilston, England, for cutting out armature discs. This press weighs 20,600 pounds. The English firm are well known leaders in their line, and supply stampings to many of the largest dynamo and motor building concerns in England. Mr. Sankey, of the firm, was in this country last year.

EASTERN CARBON WORKS have been incorporated at Rahway, N. J., with a capital stock of $200,000, to make electric carbons and kindred supplies. The incorporators are E. A. Day, Morristown, N. J.; W. Mills, and W. D. Kellogg.

THE BEACON LAMP CO., manufacturers of incandescent lamps, with an office at 120 Liberty street and factory at New Brunswick, N. J., had an involuntary petition in bankruptcy filed against it last week by Myers, Goldsmith & Bronner, attorneys for Charles Shoninger, a creditor for $500, who holds a note of the company. The company is a Maine corporation, with a capital stock of $500,000, incorporated in June, 1895, and was a reincorporation of the Vacuum Pump and Electric Company, which was organized in 1890, with $1,000,000 capital stock. The latter company had its principal place of business in Boston, where it was involved in litigation with the General Electric Company. After the present company was organized the plant was removed to New Brunswick, N. J., where it did a large business, and a number of New York merchants became interested in it. The liabilities are about $200,000, but the value of the assets is not yet known.

EUREKA TEMPERED COPPER CO. The New York office of this concern has now been removed to 141 Broadway, corner of Liberty street, known as the Washington Life Building.

MULTIPLE INCANDESCENT LAMP CO., with offices at 76 Montgomery street, Jersey City, has been formed with a capital stock of $250,000 to manufacture electric lamps. The incorporators are Ferd. von Kusserow, and Grant Green, of New York, and F. C. Russell, of Newark, N. J.

R. SCHANDA & CO., 345 East 82d street, New York City, are furnishing large quantities of fuse links, fuse wires and other specialties of that kind for electric light, power and railway service. They make these articles in capacities of from 1 up to 10,000 amperes. Their latest price list affords details, and is now being distributed. Copies and information will be gladly sent to any inquirers needing such material throughout this wide range of capacity.

MR. JOHN McGHIE, of the General Electric Co.'s advertiseing department, New York, resigned after several years of splendid but ill-requited work. He joins the forces of the "American Machinist." His office is abolished, but many of its public duties will fall to Mr. E. H. Mullin, a well-known journalist of this city.

INTERNATIONAL ELECTRIC CO., 76 Beekman street, New York City, are making a specialty of small brass parts for electrical work, including binding posts, polarity changers, nuts, fan blades, etc. An illustrated circular which the company has issued gives an excellent idea of a number of their specialties.

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The Electrical Engineer.

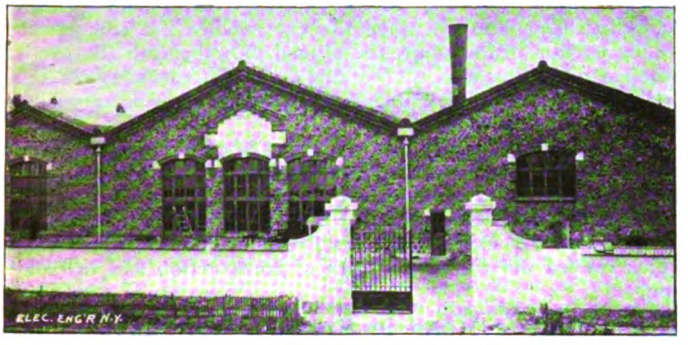
Vol. XXVII. FEBRUARY 9, 1899. No. 562.

ELECTRIC TRANSPORTATION

The Over Trolley and the Under Trolley in Paris.

THE city of Paris, which for so many years has had an excellent horse car system, has taken a definite step in advance, and is being rapidly equipped with a modern electric street car system. As far back as the year 1881, during the famous electrical exposition, a trolley was run down the Cours la Reine from the Palais de l'Industrie, just demolished to make room for the new exposition buildings; and storage battery cars were run for some years from the Arc de Triomphe to Courbevoie. A line is running now to Aubervilliers and Pantin from Paris under the mixed system—storage batteries in the city and trolley without.

The latest transformation has recently been made on the line running from the Place de la Bastille along the avenue Daumesnil through the Porte de Picpus, thence through the Bois de Vincennes to St. Maurice and Charenton. The line is part of the net work of the Compagnie Générale Electrique Parisienne de Tramways, and the installation is another step toward the general introduction of electricity upon the tramways systems

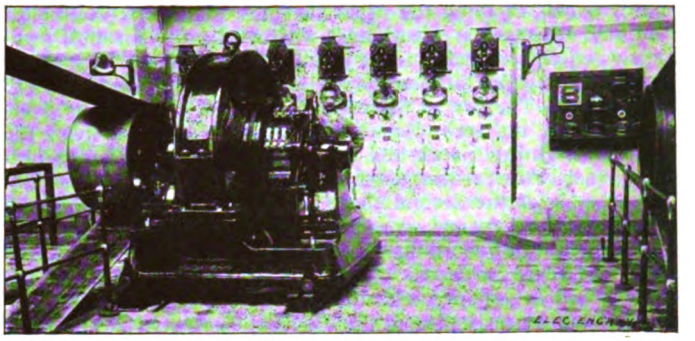


PARIS-CHARENTON POWER HOUSE.

of the French capital, as well as the transformation of many of the present omnibus lines into surface electric railways. In conformity with the franchises granted by the Conseil Municipal (of the city of Paris) and the Conseil Général (of the Department of the Seine) toward the end of 1897, the Compagnie Parisienne was authorized to install upon the Bastille-Charenton line an overhead system, for which it had made application. In the franchise, however, it was stipulated that the overhead trolley system should not be installed over the route in its entirety, exception being made on two portions of the line, that running through the Place Daumesnil and the other through the Rue de Lyon and the Place de la Bastille, two localities where the trolley would have been distinctly out of keeping with the surroundings. Furthermore, the current for the street lighting along the route was to be furnished from the Tramways power station. Work was begun in February, 1898, and completed in October of the same year.

With the installation of electricity on this line, a new practice is inaugurated in Paris, similar to that which obtains in this country. Instead of running heavy cars under a slow headway, light electric cars are run at comparatively short intervals. The result, which can readily be predicated upon American practice, is expected to have a deep educational effect upon the other tramway managers in Paris and in other large cities. Much discussion has prevailed regarding the installation of the overhead wires, and the fight, settled here after so many bitter struggles, has been waged just as bitterly in Paris. Since the installation has been completed, however, it is seen that the efforts of the company effecting it have given to the streets of Paris an ornamental overhead system which far surpasses in attractiveness many attempts at street decoration for other purposes. The fact that each of the ornamental poles along the Avenue Daumesnil, carries its electric lamp, further tends to enhance their artistic appearance.

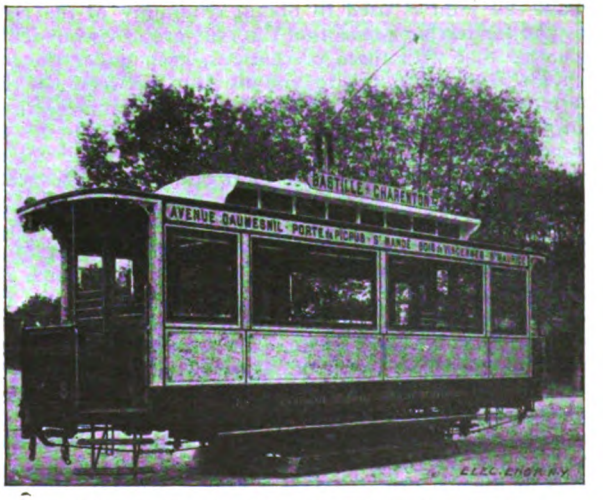
The power station is located on the Rue des Epinettes, at Sainte Mandé, at a point where this street crosses the Boulevard



DYNAMO ROOM, PARIS-CHARENTON ROAD.

Carnot and the Avenue Daumesnil. As will be seen, the building is divided into three bays, containing the boilers and the engine-room. An annex serves as a car barn. The boilers are three in number in one battery. They are semi-tubular Meunier boilers, with 200 sq. meters heating surface. The Pratt artificial draft system is employed, giving a very complete combustion and an increase of steam production estimated at a minimum of 20 per cent. The smokestack is only 17 meters (55.77 feet) high.

The engines are single cylinder Farcot non-condensing machines, each of 220 effective h. p., but capable of coping with temporary overloads of 130 h. p. While these engines are non-condensing at the present time, provision has been made to operate them condensing when occasion may arise. Each engine drives by belt a 150 k. w. multipolar railwaycompound wound generator, having series and shunt-field windings separately wound, and an iron-clad armature. Current is delivered to the switchboard at the nominal pressure of 550 volts. In addition to the generators a 250-cell storage battery, supplied by the Société pour le Travail Electrique des Métaux, has been installed. This has a capacity of 350 ampere hours at a potential of 500 volts, and has been added to the station equipment in order to give to those portions of the line operated by the underground contact system, a supply of current over an individual circuit. As the length of the conduit is only about 14 per cent. of the total length of the line the use of one of the 150 k.w. units was out of the question. To carry out, therefore, the engineering plans



CAR EMPLOYED ON PARIS-CHARENTON ROAD.

laid down it would have been necessary to install another, but smaller, unit for the conduit sections, or to set up a storage battery, to be charged from one of the 150 k.w. machines, run for some hours under full load—that is, under the best economi-

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cal conditions. This latter plan has been adopted, and current for the battery used during the day for the underground contact sections is at night, when the cars are no longer running, and the engines shut down, used for the street lighting and for moving the cars in the barn. The dynamos are provided with a special device, which allows their series winding to be short circuited by means of a switch on the board, and thus to be changed into shunt-wound machines for the purposes of charging the batteries.

The switchboard is made up of seven panels. Three are generator panels carrying the usual switches, ammeters, voltmeters and the devices just mentioned, which take the form of two-throw switches, which, in one position, place the corresponding series winding out of circuit, and in the other position replace it in circuit. The first of the remaining panels controls the overhead circuit, the second the underground contact system, the third the lighting circuit and the last the battery. Each generator panel carries a wattmeter recording the output of the machine; each of the second three panels a meter recording the consumption of energy on each circuit, while the last panel has two meters, one recording the energy put into the battery, the other the energy put out. A smaller board to the right of the main board is equipped with the instruments necessary for testing insulation, resistance of tracks, fall of potential at the rails, etc. The station has, furthermore, a well-equipped repair shop, in which the machine, tools, etc., are all driven by electric motors.

The total length of the line is 6,150 meters (3.82 miles), of which 2,630 meters (1.633 miles) are outside the fortifications, and 3,520 meters (2.19 miles) are in Paris. Of this latter portion 870 meters (952 yards) are laid down in underground conduit.

PARIS-CHARENTON ROAD—CENTRAL POLE.

The Falk rail joint is used to obtain continuity of the return circuit, and for further precaution the rails are cross bonded. It is calculated that with these precautions, even under the most unfavorable conditions, the maximum drop between the Bastille terminus and the power station will fall well beneath the limit of 5 volts specified by the French authorities.

In carrying out the overhead system, span wires are not employed. Within the fortifications, the trolley wire is suspended from double brackets carried on ornamental poles placed between the tracks and surrounded at the base by small refuges elevated above the level of the roadway. At a height of 5½ meters (18 feet) above the ground are two brackets, each supporting a 5-ampere long-burning enclosed arc lamp of the railway type, arranged five in series across a 500-volt circuit derived from the main power circuit. Each lamp is provided with an automatic and reliable cut-out. Outside the fortifications the poles are placed at the side of the track, each with a simple bracket carrying both trolley wires.

The underground contact system of the line on the Place Daumesnil, Rue de Lyon, and the Place de la Bastille, closely resembles in its construction that recently laid down in New York and Washington, and with this system our readers are familiar from the articles which have already appeared in our columns.

Connection between the switchboard and the overhead and underground sections is effected by six cables. One of 300 sq. mm. section serves for the outgoing overhead system; another of the same capacity is used as the return. For that portion of the overhead system between the Place Daumesnil and the Rue de Lyon a subterranean cable of 125 sq. mm. section joins the two ends of the trolley wire. Two other cables, also of 125 sq. mm. section furnish current to the underground conductors. As far as the Porte de Picpus these insulated, lead-covered and armored cables are placed in a trench beneath the sidewalk. Inside Paris the cables insulated, lead-covered, but not armored, are placed in cast-iron pipes laid between the tracks. This is continued to the end of the trolley line at the Rue de Lyon, where the density of traffic brings the conduit tracks as near as possible. At this point the cables, now armored, are again carried to the trench beneath the sidewalk. The last two cables furnish current for the lighting circuit. From the station to the main tracks, they are of 250 sq. mm. section. They then separate two of 100 sq. mm. section running to Charenton, and two of 150 sq. m.m. cross-section running towards Paris.

Seventeen motor cars without upper decks are used. Each has two platforms, is 26¼ feet long, and weighs 7 tons. Each carries 18 passengers inside and 18 on the vestibule platforms. Following the systems adopted in Paris, the motorman stands alone on the front platform, passengers riding only on the rear. Each car is equipped with two G. E. 800 single reduction motors and K_2 series parallel controllers. The average speed is 12 kilometers (7.452 miles) per hour. Instead of a gong, the "Wattman," as the motorman is called, presses a rubber bulb, which blows a discordant shriek on a horn. The running light, a small lamp, is fixed to the hood, and not to the inside of the car. The trolley base differs somewhat from that used in America. The tension springs, instead of being horizontal, are vertical. It looks like an earlier American type.

Current is taken from the underground conductors by means of a plow similar to that in use on the underground contact roads in this country. When the car reaches the end of the trolley portion of the route, the hinged plow beneath the car is dropped and runs into the conduit. As the car runs off the underground conduit portion of the line, the plow is raised by a hand wheel at the side of the car.

The Bastille-Charenton line is the first line in Paris of the old system on which the reduced rates of fare will be applied, viz., 4 cents inside and 2 cents on the platforms.

The entire electrical equipment is from the works of the Cie. Francaise pour l' exploitation des Procédés Thomson-Houston, which carried out the entire work of construction and installation.

Electric Road in Breslau, Germany.

Consul Erdman writes from Breslau, Jan. 9, 1899: I wish to inform our manufacturers of and dealers in street-car rails, electric motors, wire and electric supplies that the street-car company of this city, which has been using horse power, has been granted the privilege by the city authorities to employ electric motive power at the expiration of its present charter, which will be in 1902.

Automobilism in Favor in Paris.

Automobilism receives new impulse by the inauguration of the Automobile Club de France, says a cable despatch, in its new quarters in the Place de la Concorde. Another journal devoted to this sport, called "l'Avenir de l'Automobilism," has made its first appearance. Electric cabs ought to have been already for hire in the streets of Paris, as they were promised by the Compagnie Générale for January 15, but a little delay has been caused by the difficulty of obtaining accumulators from England within the specified time. These new cabs are furnished with sufficient motive power to carry them sixty kilometers. It is expected that one hundred vehicles will be in use by the end of the month. Meantime the company has utilized some vacant land at Aubervilliers as a sort of training school for the future automen, or whatever the drivers of electric cabs will be called. A track has been made, about seven hundred yards in length, on which they have been learning to manage their machines for some time. All sorts of artificial difficulties have been arranged, and obstacles have been placed at awkward parts of the track, which goes up hill and down dale in a most bewildering way.

AN AUTOMOBILE FACE. "He has cultivated an extremely mobile face." "Well, he ought to." "Ought to what?" "Automobile!"

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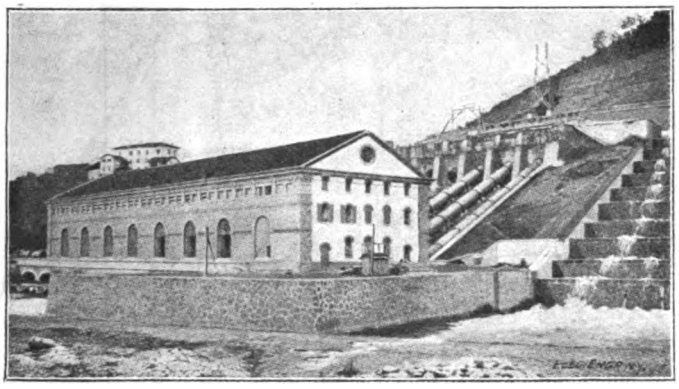
European Transmission Practice and the Water Power and Electric Plant at the Adda Rapids Near Paderno, Italy.—I.

FROM a historical as well as an engineering standpoint the Paderno-Milan power transmission scheme, has ever since its inception been a subject of considerable interest to engineers and one of pride to its projectors and builders, as well as a fitting memorial to the late Prof. Galileo Ferraris who devoted so much care and thought to this enterprise. Additional interest is attached to this installation on account of the magnitude of its operations, 13,000 horse power being transmitted a distance of 20 miles. There does not exist an installation to-day so complex



POWER HOUSE, SHOWING POSITION OF PENSTOCKS, PADERNO, ITALY.

and varied in its applications. A very able account of the details of this plant was recently given by G. Semenza before the Milan section of the Associazione Elettrotecnica Italiana, which was translated by Mr. John R. Dick, and an abstract of which is given below. As regards the hydraulic installation, a very full account of it, with a number of illustrations, was contained in The Electrical Engineer of Dec. 9, 1897, but it may be of interest to give a short résumé of the general arrangement of the works as carried out, as they are of such importance in determining the success of the undertaking. We have here a notable example of European practice in electrical power transmission.

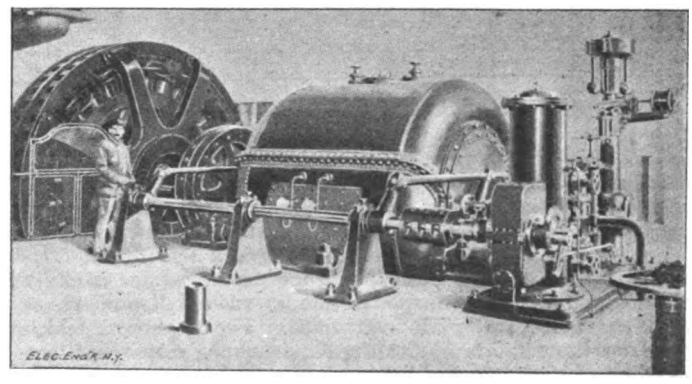
Several hundred yards down stream from the famous bridge of Paderno, there has existed for about two centuries the canal regulator of the Naviglio of Paderno, the object of which was to create a navigable channel parallel to the rapids of the river Adda. This regulator was formed of a weir and a pair of large gates which regulated the admission of water to the canal. Advantage was taken of this existing work to facilitate the new; but in order to convey 10,000 gallons of water, neither the height of the weir nor the section of the canal was sufficient. Accordingly the weir had its upper part rebuilt from that point, and the channel was enlarged from 30 feet to 43 feet, so as to be able to convey 10,000 gallons with a velocity of 4.5 feet per second. The length of this enlargement is 750 yards, that is to say, for the first section of the Naviglio and up to the point called Conchetta. At this point is the regulator of the new canal, a building which permits the passage of the water by means of seven openings furnished with sluice gates operated by hand.

A few yards below this, the canal, leaving on the left the Naviglio which runs along the picturesque valley of the Adda, enters a tunnel 115 yards long, from which it emerges into a deep trench 26 feet wide and 273 yards long. Then follows a second tunnel of 302 yards, a second trench of 385 yards, and finally the last and longest of the tunnels, which measures 1,100 yards. This makes altogether a length of 2,448 yards. The volume of water has a cross-section of 180 square feet, and for the delivery of 10,000 gallons the velocity is 8.9 feet per second. The last tunnel terminates at a point in the valley, where the banks, receding from each other, open out into a wide space, and where the configuration of the land lends itself admirably to the development of works for utilizing the energy. An ample penstock collects the water which emerges from the tunnel, and allows the motion to be gradually reduced in order to pass under the sluice gates and to enter the pipes with a velocity of about 3.3 feet per second. On the left of the penstock is the head of the weir, which has to be large enough to dispose of 11,440 gallons of water. It is formed of a flight of steps, 95 feet high and 98 feet wide. The mass of water which runs down it is thus divided and broken up, until the enormous energy it possesses is entirely spent.

The pipes which convey the water to the turbines are seven in number, and are of 6.9 feet in diameter. They are made of riveted steel plates, whose thickness is 0.315 inch to 0.472 inch. These pipes are laid to suit the natural slope of the ground, and are 215 feet long. At the top a sluice gate, electrically controlled, shuts off the admission, and at the bottom a butterfly valve prevents the flow of the water towards the turbine. From the turbine the discharge takes place into a wide tail race, which does not communicate directly with the river, but with a canal which is a prolongation of the Naviglio. As the latter re-enters the river about 648 yards above the point where the discharge from the turbines reaches it, in times of drought this section of the river would be practically without water, and would not permit of navigation. The prolongation of the canal of the Naviglio enters the Adda about 438 yards below the point of discharge at a bend of the river very opportunely chosen, and thus returns to the Adda the water which, instead of uselessly consuming its energy in erosive action on the rocks and in heat, is transformed into another form available for commercial purposes.

The delivery in times of drought is 10,000 gallons. The net fall in the dry season is 94.5 feet. In times of flood this is reduced to 81.6 feet. It is therefore necessary in order to have the same average power, whatever the height of the water, to increase the delivery in proportion as the fall diminishes, and an easy calculation shows that in times of flood this will have to be 11,500 gallons. All the canals, accessory works, turbines and tail races are designed for this maximum delivery. The power, represented, by 10,000 gallons of water per second with a fall of 94.5 feet, is about 17,300 horse power, which, with a turbine efficiency of 75 per cent., gives nearly 13,000 horse power actual output. In dividing this power into generating units, it must be remembered on the one hand that the efficiency of each machine increases with the increase of power, and, on the other hand, that the number of groups should be such that the breaking down of one should not, in practice, be a serious inconvenience. Accordingly it was divided into six units of 2,160 horse power each, while a seventh was added as reserve.

Considering the great variability in the level of the tail race, it was necessary to have recourse to suction turbines. The part of the fall which acts by pressure is 75 feet, and that by suction is 19.5 feet in times of greatest drought, and 6.6 feet in times of flood. With such a division of the fall it is possible to keep the



2,160 H. P. TURBINE AND ALTERNATOR DIRECT CONNECTED, PADERNO, ITALY.

floor of the dynamo room above the level of the highest flood, which is a matter of great importance. The manufacture of these turbines, which (with the exception of those of Niagara) are the most powerful made up till now, was entrusted to the firm of Riva, Monneret & Co., of Milan, after a competition in which the best European firms took part.

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The turbine is of the inward-flow type with twin wheels. The blades have a curved surface of a somewhat complex shape. As has been said, it acts by suction, hence the wheels always work submerged. The water enters laterally into an annular casing, 10 feet in diameter, made of steel plates, which encloses the arrangement of distributors and wheels, and it leaves by the suction pipe fixed in the concrete of the foundation. As can be seen from the drawing, the bearings are entirely outside the water chamber, so that they may be easily examined when the machines are running. The regulating shutter is a ring forming part of the distributor; when a rotatory motion is communicated to it, the guide blades open or close the admission ports. With this system, all the ports of both wheels are shut simultaneously, and the shock on the shaft is practically nullified. These turbines make 180 revolutions per minute, and each has a maximum capacity of 1,916 gallons per second. The efficiency guaranteed by the maker is 78 per cent. for a given fall and volume of water, hence, in this 22 per cent. loss, is comprised that due to friction in the pipes and bends. The whole of the turbine is easily taken apart, a most valuable feature in an installation whose working should never be interrupted. The governor, which regulates the rotation of the shutter, is of the Ganz type, the variation of speed allowed being 2 per cent. during normal running, and 4 per cent. for 25 per cent. variations of load. In order to facilitate running in parallel, the Siemens system for varying the speed of the governors will be employed. This simply consists of a small motor worked from the switchboard, which stretches or releases the spring opposed to the conical pendulum governor. By this means the switchboard attendant can adjust the speed of each turbine—or their load if running in parallel—by simply pressing a button. The turbine is connected to the alternator by means of an elastic coupling.

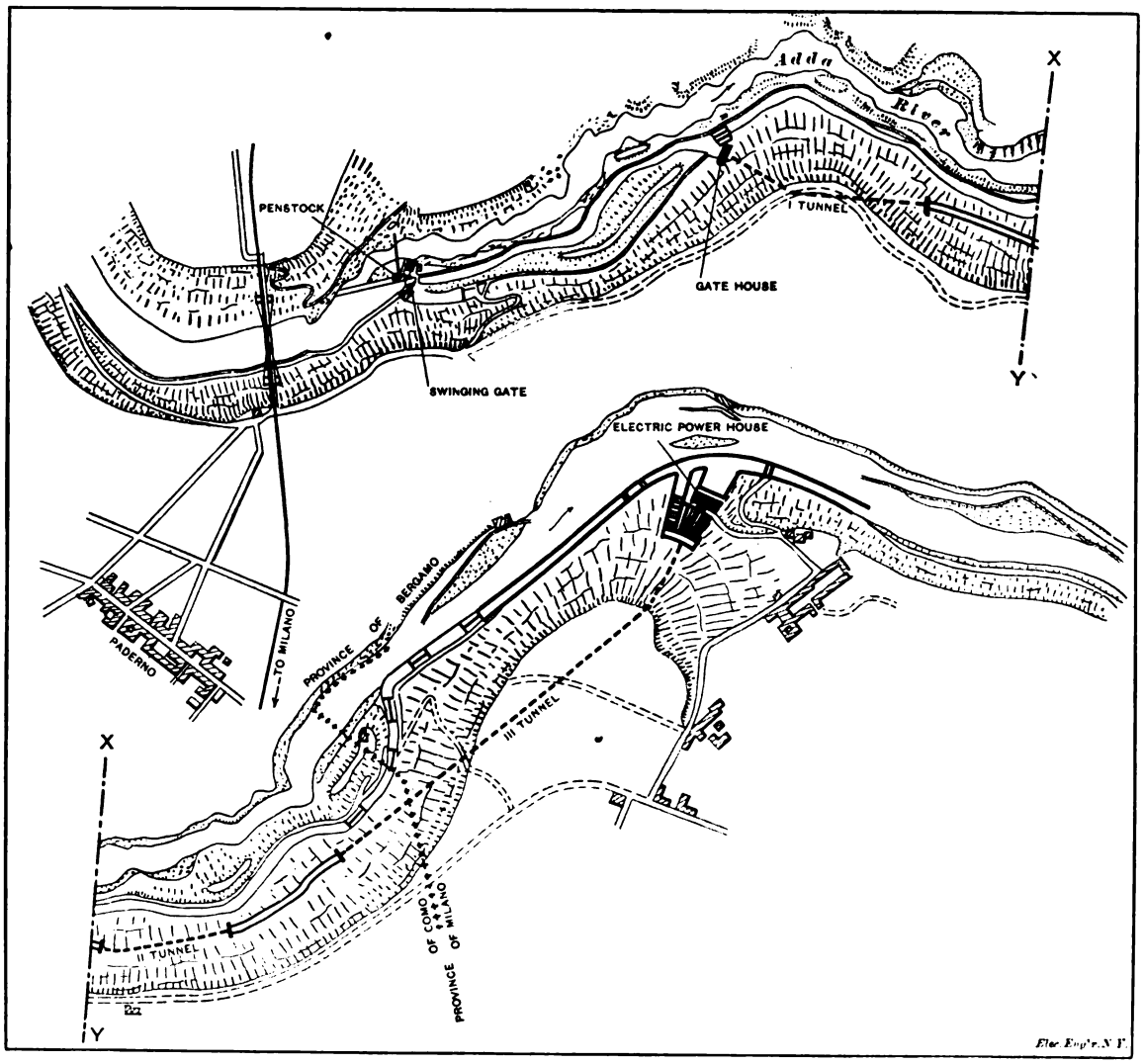
Having thus shortly described the hydraulic part of the plant, we come now to the electrical part, and will consider, first of all, the general scheme of the installations which are supplied from the central station at Paderno. The current generated by the dynamos is transmitted from the omnibus bars at the station directly to the line without the intervention of any transformers. The length of the line is 20 miles (with a branch going to Monza to furnish motive power and light to that industrious town), and it terminates at Porta Volta in Milan. The power house at Porta Volta is divided into two parts; a transformer station for the energy coming from Paderno, and a steam generating station. The transformers, as well as the steam alternators, supply three-phase currents at 3,600 volts and 42 periods. Hence they can be coupled to the same omnibus bars and help each other for the same supply. Porta Volta is thus the centre of distribution in Milan, which comprises three distinct services:

1. The distribution of energy for motors and lighting in the industrial portion of the city by an underground network with three-phase currents at 3,600 volts and a secondary network at 150 volts.

2. The supply for traction purposes with motor generators placed in the new power house at S. Radegonda.

3. The supply of the old Milan Edison network with continuous current by means of motor generators placed in the same power house at S. Radegonda.

As regards the system of current, the different manufacturing firms presented proposals for three-phase, two-phase, and continuous current. It must be admitted that, so far as simple transmission without distribution is concerned, the problem within certain limits could be effectively solved by the use of continuous currents. But when one comes to distribution the conditions are changed; it is then necessary to use motor generators, a solu-



MAP SHOWING PLANS FOR UTILIZING THE ADDA RIVER RAPIDS, NEAR PADERNO, ITALY.

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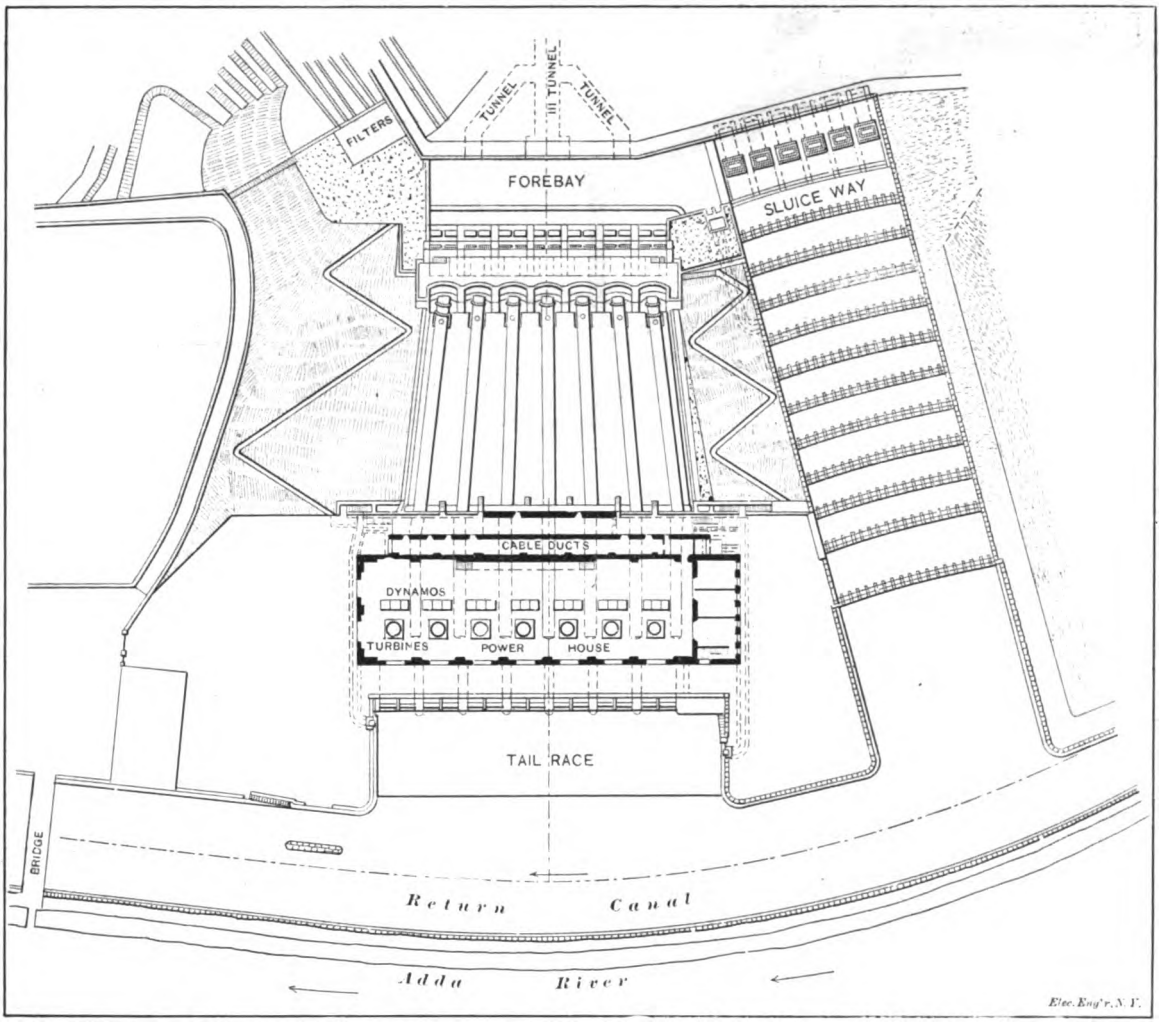
tion technically and economically infinitely inferior to that of a system with alternating currents, and destroying all the advantages which are obtained in the transmission.

In an installation, which has to supply the varied wants of a large town, a subdivided distribution is now necessary. The choice between two-phase and three-phase was not such an easy matter two years ago as it is to-day. Then the two-phase system, supported by several manufacturers and defended by authoritative opinion, occupied a sufficiently strong position. However, the illusion being destroyed that with the two-phase system the joint supply for motors and lighting was easier, and it having been proved that the transmission was less economical, this system was definitely abandoned for the three-phase, which allows of a mixed supply equally well and perhaps better, and, being



PLAN OF POWER HOUSE AND HYDRAULIC WORK, PADERNO POWER TRANSMISSION, ITALY.

perfectly symmetrical in all its parts, presents a system of distribution more uniform and more elastic.

The choice of the frequency of the current is a matter of the highest importance. After an installation is completed it is easy to change the pressure if it is not too high or too low, and to pass from two-phase to three-phase if the system is not satisfactory, but the frequency, when once the plant has been made, cannot be altered. It is now admitted that the best frequency is from 40 to 60 cycles per second, tending towards the higher limit for installations which are principally for lighting, and towards the lower limit for those in which the motor load predominates. This case was of the latter kind, and as the Edison Company already possessed an old monophase Ganz plant, in which were installed several hundreds of kilowatts with transformers constructed for 42 cycles, this frequency was selected. Already it has been proved that incandescent lamps and also arc lamps work in a very satisfactory way at this frequency.

The pressure may be chosen by superposing two curves, of which the one indicates how the outlay for copper is diminished with the increase of the working pressure, and the other how, with the same output at higher pressures, the cost of the machines, apparatus and insulation are increased. But this is an incomplete calculation, and it would be necessary for its completion to take into consideration the greater expenses of repairs and maintenance in the case of the higher pressure; and above 5,000 volts there is no experience available. For the installation of Paderno the pressure of 13,500 volts, generated directly by the dynamo, was decided upon. The direct production of the line pressure, and hence the elimination of transformers at the generating station, represents a large saving, and as the whole installation becomes very simple, the efficiency is higher, the attention required is small, and the cost of maintenance is trifling. It must be observed, however, that this was the first time that alternators of 13,500 volts had been spoken of. The question might be considered (1) from the point of view of the safety of working and of insulation which a 13,500 volt dynamo presents, and (2) under that of the efficiency of transmission, and finally under that of simplicity of the line.

When the generators of Paderno were first spoken of, there were very few dynamos at work whose pressure reached 3,000 volts. Some manufacturing firms had in their testing room machines for 10,000 volts, which had not been at work, and represented rather a type of laboratory apparatus than a dynamo machine. On the other hand, transformers of 15,000 to 20,000 volts were hardly in existence, and their safety was doubtful. And if it is possible to construct good transformers for 15,000 volts, why is it impossible to construct good alternators for 13,500 volts? As regards the objections which several manufacturing firms raised, most of them depended on their desire to follow, in the construction of machines for high tension, the same methods of construction as employed for low tension, while it should be remembered that a high-tension dynamo is a distinct type, quite different from that for normal tensions. As far as the line was concerned, it was necessary to have a pressure as high as 13,500 volts to obtain a satisfactory solution. In order to avoid a considerable skin effect, the diameters of the wires ought

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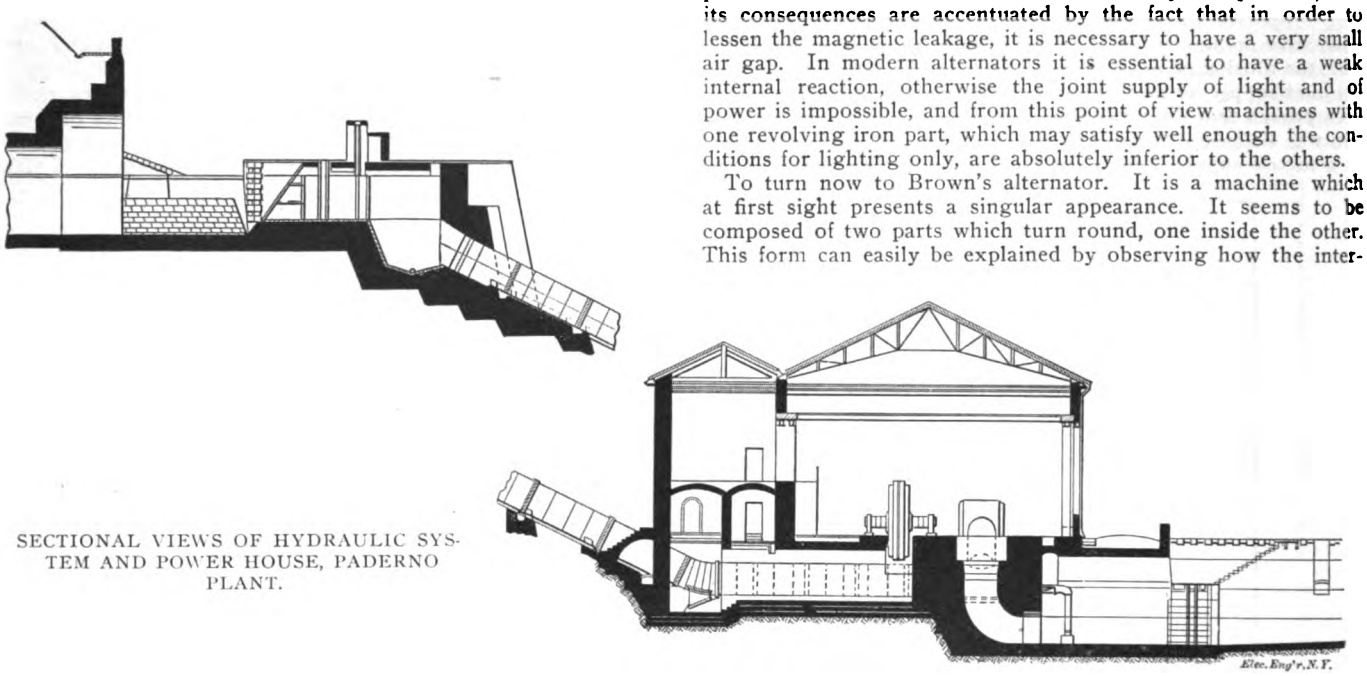
not to exceed 5-16 inch at a pressure of 13,500 volts, and to reduce the loss of energy to 9 per cent. 18 wires were necessary. With 10,000 volts and using 18 wires this loss would amount to 17 per cent., and to reduce it to 9 per cent. 36 wires would be required. Hence the solution with 13,500 volts was simple and economical, and, having the authoritative sanction of Prof. Ferraris, was



SECTIONAL VIEWS OF HYDRAULIC SYSTEM AND POWER HOUSE, PADERNO PLANT.

boldly and deliberately selected. Precautionary measures were taken, however, and the plant was constructed so that, should any unforeseen phenomena arise causing a disturbance, the change to a much lower pressure would be possible without any alteration.

We may summarize the principal data of the three-phase alternator as follows: The power absorbed is 2,160 horse power, or 1,590 kilowatts, the speed 180 revolutions per miuute, the frequency 42 cycles per second. The difference of potential between the wires of the three-phase system is 13,500 volts.

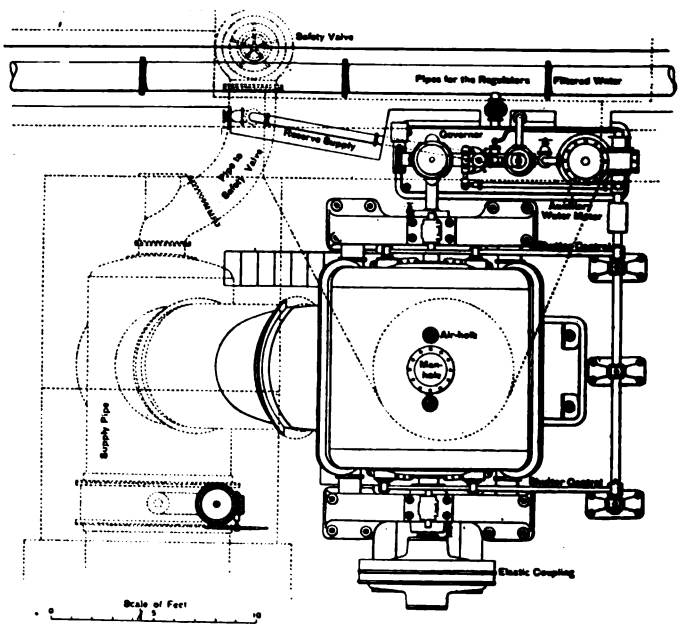
The construction of the machines and of the switchboards was entrusted to the well-known firm of Brown, Boveri & Co., of Baden. The dynamo is of the type with fixed armature circuit, and a revolving field magnet having a number of pole pieces.

The advantages of the inductor alternator over others are principally as follows: The thorough mechanical construction of the revolving part, the abolition of rubbing contacts, the smaller consumption of energy for excitation with a higher efficiency. It is not necessary to stop to prove that these are real advantages; indeed, the fact of not having wires and coils carried round with considerable peripheral speed and exposed to the action of centrifugal force, which tends to damage the insulation, is in itself a very valuable thing. The abolition of rubbing contacts eliminates a source of trouble, which is by no means negligible. The saving in the excitation by the employment of a single coil instead of a number of coils may increase the efficiency by 1 or 1½ per cent.

Let us now look at the disadvantages. Not to mention the inconvenience of having an exciting coil of 16 feet or 18 feet in diameter, we cannot attach too great importance to the fact that, as the iron is badly utilized, these machines are much heavier than others of equal output, and that in many cases this greater size may be very disadvantageous. Let us look next at the enormous leakage of magnetic lines and its effects. On examination of one of these machines it is clear that the external portion of the fixed part and the shaft of the revolving part are free poles of an electromagnet. At light loads there are but few lines of force which pass through the shaft and supports instead of passing through the air gap, but when the load increases, and gradually the internal reaction is felt, the lines which escape through the air assume considerable importance, especially if the difference of phase is somewhat large. The proof of this is that all magnetizable objects near the machines are magnetized; for instance, it is necessary to make of bronze the regulators, governors and the parts of the steam engines which are directly coupled to the alternators. The number of leakage lines may become so great that on reaching a certain point it is impossible to increase the pressure, however much the excitation is increased.

To this, if to nothing else, should be attributed the non-success that almost all manufacturing firms have had to record against the machines first made of this type. The whole aspect of this phenomenon called internal reaction is very complicated, and its consequences are accentuated by the fact that in order to lessen the magnetic leakage, it is necessary to have a very small air gap. In modern alternators it is essential to have a weak internal reaction, otherwise the joint supply of light and of power is impossible, and from this point of view machines with one revolving iron part, which may satisfy well enough the conditions for lighting only, are absolutely inferior to the others.

To turn now to Brown's alternator. It is a machine which at first sight presents a singular appearance. It seems to be composed of two parts which turn round, one inside the other. This form can easily be explained by observing how the internal construction differs essentially from all other machines of this kind. As a rule in the dynamo the fixed parts rest on wide lateral supports to which the bearings are attached. This machine on the other hand rests entirely on the bearings. To the inner side of each bearing is fastened a carrier having a cylindrical surface, and the armature ring is supported by several spokes joining on to a nave which is fitted to this cylindrical surface. This arrangement renders the manufacture simpler and has two



PLAN OF ONE OF THE TURBINES.

special objects in view. The first is to ensure the perfect centering of the fixed part relatively to the revolving part, as everything can be adjusted by subsequently turning the bearing blocks; the second is to facilitate any repairs. In fact, should anything happen to the lower part of the armature it is only necessary to raise the bolts which are set at the sides of the machine, and to turn the external part round the two cylindrical expansions of the bearings by means of a lever.

The revolving part presents some interesting features as well.

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28 poles of cast steel are fastened by two bolts to its periphery. The winding of these poles is not made with wires or strip in the ordinary way, but is constructed as follows: A flat bar of copper 0.157 inch thick and 1 inch to 1.18 inches wide is wound into a helical form, the turns being insulated from each other by sheets of paper, and the resulting solenoid is compressed hydraulically. A winding is thus obtained which is very solid mechanically, and which does not suffer from the action of centrifugal force. The windings of the armature are passed through tubes of micanite paper. This method of winding is costly, and requires considerable labor, because the coils have to be wound on the machine itself, and have to be passed turn by turn through the tubes; but the use of an internal jointless tube offers great security with high pressures. These tubes project about 4 inches from the iron, so as to prevent sparking between the wires and the frame, and the wires themselves are carefully separated by about six inches. For this reason the machine is a great sucess, but all this care has to be taken in order to obtain an effective insulation.

Each alternator drives its exciter from its own shaft, which is the most economical and simple arrangement. It is true that direct coupling of the exciter has the inconvenience of increasing the variations of pressure due to the variations of speed. For example, as the speed diminishes the pressure will diminish proportionately, and the pressure of the exciter will also be reduced for the same reason, hence the total diminution of pressure of the alternator will be more than proportional to the variations of its speed. Nevertheless, in practice this is not a serious objection, especially if the internal reaction is weak, and also because of the magnetic inertia of the machine. On the other hand, the use of separate exciters requires extra turbines, supply pipes and valves, all of which complicate the plant and increase the expense.

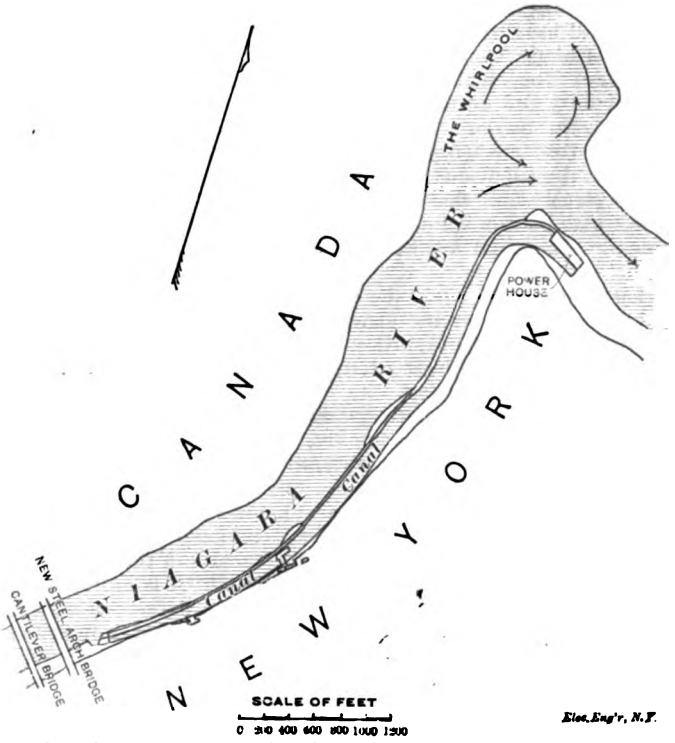
The internal reaction of this machine is feeble, in fact, it is guaranteed to be within 5 per cent. for a non-inductive load, and 16 per cent. for an inductive load, with a power factor of 80 per cent. The promised efficiency at full load is 95 per cent. in the first case, and 93 in the second. These alternators are capable of absorbing the full amount of 2,160 horse power, with the above efficiency, when the power factor is 80 per cent., and they can in this case furnish 80 amperes after running 24 hours at full load. This is what determines the size and power of the machine, and it is the only exact way of stating it. Any statement regarding the power, which does not take into account the power factor, is absurd.

The method of fixing turbines and alternators in the dynamo room can be seen in the illustrations. The supply pipe passes under the alternator before reaching the turbine. This arrangement was made in order to keep the alternator quite clear of the water discharged, and to interpose a solid wall which would perfectly protect it from dampness, especially in times of flood. Besides, it makes it easier to carry the high tension conduits from the machine to the switchboards, as these are fixed on that side of the dynamo. The dynamo room in itself does not present any great peculiarities. Great care was taken to secure a good natural ventilation by putting plenty of windows high up. An electrically-driven crane facilitates the operation of dismounting and repairs.

The Birkinbine Plan for Utilising Niagara Gorge Power.

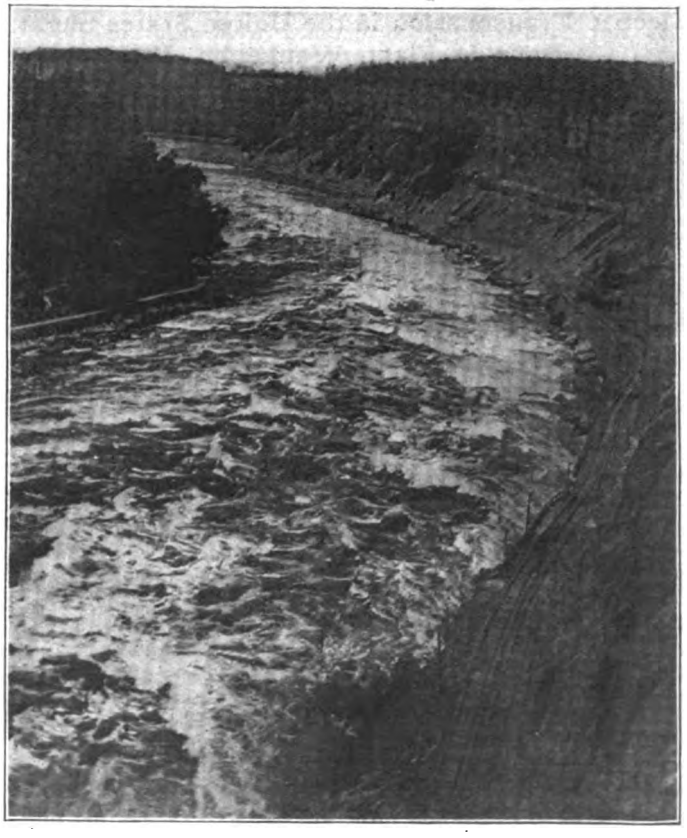
A PLAN to utilize five per cent of the waters of the Gorge and Whirlpool Rapids at Niagara and convert it into 35,000 electrical horse power with an outlay of nearly $2,000,000, has just been completed by John Birkinbine, a prominent Philadelphia engineer and president of the Franklin Institute, for a party of New York and Buffalo capitalists. The main idea of the scheme is to utilize the forty-five feet head of water between the international bridges and the whirlpool by conducting the small percentage of water named through a canal along the base of the gorge and inside the tracks of the Niagara and Lewiston Railroad, known as the Gorge Road, so as not to interfere with the scenery in any way. The power house is to be located just around the bend of the river below the whirlpool. In speaking of the project Mr. Birkinbine said recently: "The average flow of water through the gorge is from 166,000 to 275,000 cubic feet per second. The speed of the water rushing down the gorge is 21.75 miles per hour—that is, from the bridges to the whirlpool."

The new project is to divert a portion of the water from the river below the bridges into a canal separated from the stream by an embankment or wall, which will also carry the



MAP SHOWING ROUTE OF CANAL AND LOCATION OF POWER HOUSE.

roadbed of the Niagara Falls & Lewiston Railway. Owing to the velocity of the river, it is proposed to construct an entrance



NIAGARA GORGE, NEAR WHIRLPOOL.
(Showing Track Under Which Birkinbine Canal Would Be Cut.)

which will practically be a monolith of concrete or mass of masonry, pierced with openings, through which the water can pass into the canal. The excavation of the canal, which will involve

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the removal of enormous quantities of rock and debris, will be conducted at a low cost by hydraulicking or washing the loose material away by strong streams of water. Most of the waste material will go into the river, but the harder and better rock, which will have to be blasted down, will be utilized in the construction of the bank for the canal, the power house and other purposes. The canal will deliver 10,500 cubic feet of water per second or 5 per cent. of the normal volume passing through the Niagara Gorge. Making allowance for head lost in the canal, and for efficiency of water wheels, this volume of water can, with the fall available, produce 35,000 electrical horse-power.

The plans admit the water about 300 feet below the bridge, from which point a fall of 45 feet to the outlet at the whirlpool is secured. The canal will be 5,300 feet in length and average 100 feet in breadth.

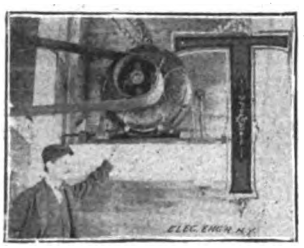
It is proposed to equip the power house just below the head with water wheels, electric generators, exciters, etc., and to carry the railway track over a portion of the power house to allow free vent for tail water without interfering with the scenic features of the railroad.

The present price per horse-power at Niagara Falls is based on a charge of $20 per annum for one electrical horse-power continuously applied, or $12 for a dynamic horse-power delivered on water wheel shafts at power house. By the proposed plant it is anticipated they shall be able to reduce the prices per horse-power considerably below the present charges.

Though the cost of constructing the canal and the power installation will reach nearly two million dollars, it is estimated to be less costly to build than a similar plant to develop the same number of horse-power erected to utilize the vertical drop at the falls.

The plan proposed does away with deep wheel pits, long tail race tunnels, which are so costly to build, and the expense of passing through valuable property necessary in the other plants. The plans, which are now in the hands of the promoters of the project, who express confidence in their ability to carry it through, provide for the rise and fall of the water in the river due to the variations of winds on Lake Erie. The maximum variation is about 15 feet.

Electric Transmission in the United States Sugar Refining Plant, Waukegan, Ill.



Bracket Induction Motor.

THE ELECTRICAL ENGINEER has from time to time taken up the application of electric power transmission in plants of various important industries. It is this time able to deal with the first application of electric factory transmission on a large scale to a glucose sugar refinery, the plant being that of the United States Sugar Refining Company, about forty miles north of Chicago, at Waukegan, Ill. This is a plant of good size, its capacity being a consumption of about 15,000 bushels of corn per day, the products being glucose, sugar, feed and oil. The plant was started in 1890, but has recently been going through a remodeling and enlargement under the supervision of P. L. Saenger, engineer. As the enlargement called for some new buildings separate from the main power plant, the question of the feasibility of electric transmission naturally came up because of the loss of power in shafting and belts that would be necessary with buildings so scattered. The main building is on one side of a railroad track, while on the other side and not opposite is a new feed house in which a large amount of power is required. After it was finally decided that the extensions of the plant should be driven by the electric method while retaining the old line shaft method already in use in the old part, the question came up as to whether direct or polyphase apparatus should be used. The lower first cost and simplicity of distribution with the direct current plant was balanced against the simplicity and ease of maintenance of the polyphase motors due to the absence of commutators. It was concluded that the first cost of the polyphase apparatus was justified by the simplicity of the motors, which being commutatorless require no attention save oiling of the bearings the same as the shafting to which they are belted. The absence of any possibility of sparking on the motors due to the absence of any sliding contacts was also a factor in determining the type of apparatus to be employed because in some places around the refinery the dry dust in the air would make sparking commutators a source of danger.

The two-phase system was adopted and the contract for all the motors and generators given to the Westinghouse Electric & Manufacturing Company through its Chicago office. The generation and distribution is on a 440 volt, two-phase system with a frequency of 60 cycles. No transformers are used between the generators and motors, the motors being wound to take the 440 volts direct, but for lighting transformers are used to step down to 110 volts. As nearly as possible an equal number of lights are run on each phase, and the lights are in some cases run on independent feeder circuits.

Some idea of the magnitude of the plant may be had from the following enumeration of motors put to various uses. In the feed house, which is a new building just added to the plant 460 feet from the engine and dynamo room, a number of large motors are used on each floor. On the first floor are a number of dryers, which are run by three 20 horse power motors. The starting switches for these motors are on the first floor where the workmen are, but the motors themselves are under the floor in the basement, being however suspended by heavy timber work from the first floor. These motors have a belt on each end of the shaft, one belt running one machine on one side, the other belt running another machine on the other. There are also on the first floor of the feed house some conveyors and general machinery driven by two 20 horse power motors. On the second floor of the feed house are three 30 horse power motors belted to grinding mills and conveyors. The third floor has two 20 horse power motors belted to presses, conveyors, etc. In the cupola of the feed house one 30 h. p. motor runs the agitators in the tanks. In the oil house, 350 feet from the engine room, three 50 h. p. motors drive roller mills, and one 40 h. p. drives conveyors and elevators. In a warehouse, 200 feet from the engine room, are one 15 and one 20 h. p. driving agitators and general machinery. In the boiler room there is one 20 h. p. motor driving coal and ash conveyors. This makes a total of 485 horse power in motors.

The generating plant consists of two 180 k. w. and one 75 k. w. two-phase alternators, each belted to an Ames Iron Works high speed engine of corresponding capacity. The engines all run at 260 revolutions per minute, and the two large generators at 514: the small generator at 720.

The switchboard is arranged so that the generators can be run in parallel or when there are only two generators running they can be run independently on two separate sets of bus-bars with which the switchboard is provided. This makes a complicated board, but the arrangement is very convenient, because the two sets of bus-bars make it possible to divide the load on two generators before they are thrown in parallel. Each generator panel has a double throw four pole switch, by which the generator can be thrown on either set of bus-bars. On another panel is also provided a single throw four pole switch, by which the two sets of bus-bars can be thrown in parallel. It is the intention to operate the plant in parallel most of the time.

The parallel running of alternators is now becoming quite common in this country, but is not as well understood as it should be. Where alternators are driven from the same countershaft the problem is very simple, for if the pulleys are just the right size, the speed of the machines must be the same. Where, however, each generator is driven from a separate engine, as is usually the case, the problem of throwing in parallel is far more difficult. In order to have the machines run together successfully and take their proper shares of the load, the engine governors must be adjusted to give exactly the same speed with the machines operating at the same relative loads. This means, however, that when one machine is loaded and another machine has no load, as is the case in starting up a new machine to be thrown in and help carry the load, that the machine with no load will run at least 1 per cent. faster than the one with load, which is a variation in speed too great to allow the switchboard attendant time to throw them in parallel at the instant the phases are together. Sometimes the speed of the unloaded engine is cut down by the throttle and the throttle suddenly opened the instant the machines are thrown together; but such a method is manifestly slow and requires skilful manipulation. The most satisfactory way is to load both machines as nearly the same as possible, and then throwing in

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parallel becomes easy. In order to load both machines independently before throwing in parallel, two sets of bus-bars are necessary.

In this plant, phase lamps are used to indicate when the generators are in step. A set of eight 110-volt lamps in series is connected in a plug circuit, so that when the synchronizing plug is inserted on the board one lead of each of the circuits to be synchronized is connected to the ends of this series of eight lamps. The lamps will get no current if the machines are exactly in step, because a potential of the same value and direction is applied to the two ends of the lamp circuit. If, however, the machines be exactly out of step, the lamps will get the voltage of one machine in series with that of the other, or 880 volts. The frequency with which the lamps flash up or the time between the beats depends on the difference in the speed of the machines; and unless the speed is very nearly the same these beats come rapidly. When the speed is nearly the same, the beats come slowly enough, so that the attendant can close the paralleling switch about midway between the time the lamps go out and the time they flash up again. Once the alternators are in parallel they will stay there as if locked, but unless the speed of the engines is right the slow engine cannot be made to take its share of the load. Each of the two circuits of the two-phase system must have its synchronizing lamps, because one phase might be in step and the other out of step.

Each generator panel has a Whitney alternating current ammeter in each of the two circuits, and a Whitney alternating current voltmeter in one circuit. The switchboard is of white marble and was furnished by the Crouse-Hinds Electric Company of Syracuse, N. Y The wiring of the plant was done by David Cronin, of Syracuse.

TELEPHONY AND TELEGRAPHY

The Telephone Situation from a Bell Standpoint.

MESSRS. POOR & GREENOUGH, of Boston and New York, who are closely identified with Bell telephone interests, have issued an interesting circular on the growth of the telephone business. The gist of it is as follows: When the American Bell Telephone Company took the business of the National Bell Telephone Company in 1880 there were in the entire country, but 28,316 miles of wire and 132,692 instruments in use. To-day there are nearly 900,000 miles of wire in use and over 1,000,000 instruments. This immense business is directed by the American Bell Telephone Company. the parent company, through its ownership in the more than fifty sub-companies throughout the country. The main artery of the whole structure is the long distance telephone, stretching over the country, connecting with most of the sub-companies, thereby securing to the whole system continuous telephonic connection. The long distance telephone is conducted under the name of the American Telegraph and Telephone Company, and is owned and controlled by the American Bell Telephone Company.

The amount of capital invested approaches $200,000,000, the item alone of real estate owned by the sub-companies throughout the country equalling about $10,000,000. Up to within a few years this system has been financed by the sale of the capital stock of the various sub-companies, by which the fresh capital, continually needed by an ever increasing demand for telephonic facilities, has been supplied; and also by the sale of fresh issues of American Bell Telephone Company's stock to enable the latter company to take up and pay for its proportion of the shares at par of the new stock issued by the various subordinate companies. More lately, however, the course pursued to raise the additional capital to provide for the new construction in the sub-companies required by the increasing demand has been to issue bonds secured on property and plants previously created.

This class of security has become very popular of late. The bonds are issued only after a large amount of money has gone into the properties. The surplus of value behind the bonds of the best companies is much in excess of the bond issues, in which they differ from many of the bond issues of railway companies, which often represent only the original cost of construction. In operating the sub-companies, an amount of from 8 to 10 per cent. of the capitalization is charged off yearly, and is included in the accounts of such companies as a part of the operating expenses.

This industry is so strongly entrenched, says the circular, that the appearance of opposition companies occurs only in exceptional cases, and is of but little consequence, for the expectation of successful competition with the larger companies rests upon a very precarious foundation. First, because their business can never be anything but local, as they have no means of interstate communication; second, it has been characteristic of these smaller opposition companies that the principal object of their promoters has been to force them upon the Bell Company, or when such sale was not possible, these enterprises have generally fallen into the hands of the manufacturers of telephone apparatus, for the purpose of acquiring thereby a market for their appliances.

The telephone industry, as represented by the American Bell Telephone Company and its various sub-companies, is resting to-day upon a more permanent basis then ever before in its history, and the steady growth of the past is clearly indicative of the almost unlimited development in the future—a tendency clearly visible in the published reports of their business from day to day. Telephone bonds issued on a conservative basis by the better companies are growing rapidly in favor as a subject of careful investment, because, while well secured, they still offer higher rates of interest than the older forms of favored investments. The general public have not yet learned to appreciate the opportunity that this class of security offers. The New England public—ever the most intelligent as well as the most conservative of investors—were the first to undertake these issues and to absorb them. The demand for these bonds has increased so rapidly that the opportunity to obtain them upon the present basis of return will not long remain open, for these securities need only to be examined and understood to be ranked with investments of the highest grade.

Telegraphy in the Philippines.

The transport Morgan City will carry from San Francisco on her next trip to Manila 325 miles of telegraph wire, with a corresponding quantity of material to erect that much line, sufficient equipment for five construction and repair parties, equipment for forty separate telegraph offices and four and one-half miles of submarine cable. The Chief Signal Officer at that post, Colonel Green, procured the entire outfit, in compliance with instructions from the War Department at Washington, purchasing everything needed in the city at an outlay of about $10,000. The outfit is complete in every detail, the proposed lines being so far remote from the base of supplies that the equipment had to be made complete in all that is needed in and out of a telegraph office.

In New York City the United States Government is buying all kinds of material for cables and cable laying to connect the islands.

Bell Telephone Output.

The American Bell Telephone Company reports the output of instruments for the month ended January 20 as follows:

	1899.	1898.	Increase.
Gross output.....	46,548	25,861	20,687
Returned	14,719	10,041	4,678
Net output.....	31,829	15,820	16,009
No. of instruments outstanding..	1,156,675	1,124,846	31,829

Western Union Telephone Holdings.

An item in the Boston "Advertiser" financial news says: "In the proposed American Bell Telephone consolidation holdings of Western Union have been taken into consideration. It is understood that an offer of 225 was made to W. U. for 37,364 shares of N. Y. Telephone, scheduled at par in last W. U. list of stocks held. This would give W. U. something like $8,400,000 for this asset. In addition an offer has been made to take 3,175 shares Southern Bell. At last W. U. directors' meeting these propositions were considered, but it was decided to withhold acceptance for further consideration."

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THE

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Solutions of the Space-Telegraphy Problem.

PROBABLY a much better term could have been selected for the designation of Marconi's wonderful invention in signal transmission and the subsequent work of Slaby, Lodge, Preece and others, than "wireless telegraphy" as one of the main features of the former's invention was the employment of long vertical wire terminals, and the latter investigators' labors were not directed towards the abolition of wires in telegraphic operations. In fact, recent observations and disclosures seem to indicate that Marconi's discovery will go down in history with the name of the discoverer attached, similarly to that of Röntgen, so that in the future we will hear of it as the "Marconi system." Yet who knows but that, after all, "wireless telegraphy" was but a phantom chased in the endeavor to discover an enduring commercial method for signalling across space? We mean to imply by this, that a non-metallic system of telegraphy will in all probability only be used under conditions where metallic circuits are impracticable, and there are remarkably few land areas that cannot be spanned by wires. After all that has been said and written about non-metallic telegraphy every one must concede the great advantages of the metallic circuit system, namely, the privacy of the messages, the simplicity of the apparatus, the speed of transmission and the possibility the system offers for working by telephone. Space-telegraphy, on the other hand, is at present limited to comparatively short distances, and its usefulness is confined to spanning estuaries, skirting seaboards, and for the purposes of offering a means of communication in case of accidents to a cable. In fact, its present chief mission is to replace submarine cables between moored vessels and the shore, i. e., between lightships or island lighthouses and the coast guard stations. It so happens that the weak point in submarine cable communication becomes the point in favor of space-telegraphy. And if for no other reason, as we pointed out last week, than to bring lightships and lighthouses, in their isolated positions, into closer touch with the shore for daily advice and report, such a system of communication deserves the time, thoughts and best endeavors of every scientist. Italy, by Marconi's labors, gave to the world a coherer system of space-telegraphy, based on the work of Hertz and Lodge. Others like Tesla, Preece, Slaby, and Evershed have worked in similar channels; and we have to-day a record of a twenty-five-mile transmission by means of the Marconi system. The close of last year seemed to reveal among the indefatigable English scientists a change of attitude with respect to this all-important subject and one which may before the end of the century definitely settle the question as to the most feasible method of telegraphing across space. We refer to the three papers read recently before the Institution of Electrical Engineers by Dr. Lodge, Mr. W. H. Preece and Mr. S. Evershed, respectively, on "Improvements in Magnetic Space-Telegraphy," "Aetheric Telegraphy," and "Telegraphy by Magnetic Induction," all emphasizing the merits of one and the same system of space telegraphy.

Mr. Preece, in describing his alternating current induction system, claims that with it he can transmit messages over as great a distance as has been done by means of Marconi's system. On the other hand, the speed of signalling by means of the latter system is limited to something like twelve words a minute, and we must conclude that it is partly this circumstance which handicaps the method.

Dr. Lodge in his paper gives us a somewhat academical aspect of magnetic space-telegraphy. He describes a new magnetic receiving device for magnetic induction telegraphy, and explains the method for putting it in practice. He further includes the theory of two circuits arranged in mutual syntony, and gives information and suggestions as to the proper course future experiments should take. The advantage of syntony is discussed and the relative importance of conduction and induction is considered together with a detailed investigation of the theory of "detectors" for such a system. Mr. Evershed recites the improvements in his apparatus which he first proposed in May, 1896, when he suggested an "inductive method" in a report to the Royal Commission. He describes in the present paper a "call" or receiving apparatus, which enables exceedingly minute currents to be detected. He seems to be unaware of the work done in this country by Caldwell and Blake, who in a report to the Lighthouse Board of the United States, dated June 30, 1895, make the following statement: "The receiving apparatus or relay for this system would be vibratory in character and timed to a frequency of vibration to correspond with the period of the calling current." However, Mr. Evershed is said to have used a vibratory indicator on the synchronous principle in 1892, so that if this be the case, there can be no question as to priority.

In strong contrast to these English labors, though not perhaps as a very pretentious rival, we must refer in this brief résumé to Prof. Zickler's "Lichtelektrische Telegraphie," fully described and ilustrated in The Electrical Engineer of January 26, 1899. Prof. Zickler makes use of an old discovery due to Hertz, that ultra-violet light is able to reduce the spark-resisting power of an air gap. Such experiments are very atrractive from a purely scientific standpoint, but it is not easy to see the advantage of this method as compared with that of the ordinary heliograph. Using the simplest kind of apparatus, Prof. Zickler succeeded in signalling by this means across a space of two meters, and by the aid of an arc lamp that expended nearly two horse power, and by the use of quartz lenzes, the distance was extended to 200 meters. The speed of receiving the signals is not mentioned; the extreme limit is probably about twelve words a minute.

Comparing, then, the various methods and keeping in mind that we are here concerned with a practical question for engineers, rather than with the scientific aspect of space telegraphy, it might be inferred that the "coherer" systems as a whole are about to be left behind in the advance of the art and that preference is to be given to alternating current inductor systems for coast telegraphy. If this is to be the case, the problem is greatly simplified, and experiment resolves itself into the single task of finding the best design of apparatus for communicating between a moored lightship and the shore by means of inductor coils. This is a development that one would gladly and hopefully see Mr. Tesla concentrate upon, with all the experience and insight that years of study of the problem have given him.

Imports and Exports.

IT has been truly said that man shall not live by bread alone. He needs a diamond or two occasionally, and this is why we may expect to see imports go up from the present marvelously low level. The latest returns just completed show the smallest importations by the United States in twenty years, while the exports have been not less than $621,000,000 in excess of imports. The demand for our food and manufactured products is so great, the exports should continue as large as ever, but it is hard to believe that with such prosperity as this country is now entering upon, the imports will remain as small as indicated above. Indeed, recent months have suggested a coming increase, and as the consumption of the American public must increase with its numbers and wealth, imports of luxuries should gain steadily. The word "luxury" is used advisedly, for the time has come when not a single article of "utility" will be imported because it

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is of foreign origin, unless there is an actual, tangible reason to justify its purchase, in price or merit or quality of being unique. This country in 1898, exported goods to the value of $1,254,925,000 and imported goods to the value of $633,600,000, the latter item declining $100,000,000 and the former increasing more than $150,000,000, in regard to the preceding year.

Looking into the returns, it is seen that imports of articles for use in the mechanic arts amounted to $39,961,000, or $16,000,000 less than in 1897, while materials in a crude condition ran up from $32,500,000 to $49,000,000. These are good figures, but it does not follow that they should persist. The day is approaching when it will be impossible to reconcile the gigantic export trade with the present high duties on imports, and when that arrives the American manufacturer in the scientific adjustment will be afforded his real opportunity to enjoy on the best terms the profit of the markets of the world.

Municipal Debts and Data.

THE way Massachusetts cities and towns are running into debt is simply amazing, as shown by the figures of Commissioner Endicott, and the craze for municipal lighting plants and waterworks is not calculated to check the process. The net debt has increased in 128 towns. The aggregate net debt of the cities and towns in the State is $121,385,139, which is larger than ever before. The debt has been advancing every year since 1885, when it was down to $63,306,213. Last year it was $115,798,889, and the year before it was $104,704,875, while it has not been more than $100,000,000 in any previous year. The percentage of the net debt to valuation is .043. This is much larger than in most years for a generation. Last year it was .042, but the equal of this is not reached till the years 1877 to 1881, when it was the same as last year, except that it was .044 in 1880. Assuming that the average rate of interest is 4 per cent., which is low enough, then these municipalities raise $6,712,457 for interest every year. The gross debt for waterworks was $50,012,944, and the sinking funds for it amount to 27 per cent. of the debt.

Outside of Massachusetts the burden of local debt and taxation is also rolling up merrily, and it is often done in a way that augurs ill for the final results. Last week we quoted a report to the effect that the investigation of the United States Department of Labor proved municipal ownership to be anything but profitable, but municipal bonds are still mounting up and up in volume, and still the old yarns float around in novel and varied forms. Norristown, Pa., for instance, comes to the front with the preposterous statement that it is expending only 36.50 per annum for each arc light from its municipal plant. No details are given, but as the steam power alone for a good full arc each year costs $40 on the average, this Norristown fable must go its downward way speedily. As an offset comes the confession from Easton, Pa., that its municipal lighting plant is a rank failure owing to "too much politics and resultant mismanagement." What have politics to do with a simon-pure municipal plant, anyway?

Electrifying the Moribund Elevated.

THE important announcement was made last week that the well-known banking firm of Kuhn, Loeb & Co., would underwrite a forthcoming issue of $18,000,000 worth of stock which the Manhattan Elevated Railway will put out to raise money to equip its road with a new motive power. A member of the firm of Kuhn, Loeb & Co. said they had underwritten this issue of $18,000,000 of Manhattan stock designed to provide funds for the equipment of the property with other motive power than that in use at present. They did not know, however, what the new motive power will be, whether electricity, air power or any other system. According to the directors of the Manhattan Elevated Railway it has not been decided as yet whether the new motive power with which the road is to be equipped will be compressed air or electricity. Mr. Russell Sage has been distinguishing himself as usual by his nasty slurs and foolish criticisms on electricity and compressed air, about the uncertainty and unreliability of electricity and the remarkable successes being attained with compressed air. Such nonsense makes us very tired. Mr. Sage is old enough to know better, and is so old, in fact, that we can only fear that some one is taking advantage of his senility to fool him. The other explanation would be that he is "standing in" with those who are now unloading compressed air stock in Wall street at high prices and at a great rate, without there being a single, solitary successful compressed air locomotive, car, cab or vehicle of any kind whatsoever, in operation, anywhere in this country. Mr. Sage can take his choice of these propositions. His good faith is being seriously impugned and not by us either.

When one turns to the accomplishments of electricity, the outrageous character of Mr. Sage's fictions attacking it become the more noteworthy. While compressed air after trials for half a century has literally disappeared from the tracks of every class of road, electricity has gone on conquering and to conquer. There are to-day in the United States alone 15,000 miles of electric street railway track and 40,000 cars, and the people spend annually $115,000,000 riding on them and in them, with far more regularity and much more comfort than the elevated has ever afforded under Mr. Sage's grasping, grinding management with steam. If Mr. Sage is not to blame for the Elevated policy, we withdraw our remarks, but it is pretty broadly stated that the Gould family would long ago have made the necessary improvements and adopted the motive power of the age, but for his persistent opposition. Possibly such stories do Mr. Sage injustice, but he should at least stop his ridiculous jabber about the shortcomings of electricity. Such deficiencies exist only in what must be characterized as either his prejudice or his ignorance, and, as we said above, he is old enough to know better. If there is any real merit in compressed air, no opposition can keep it back. Electricity having already proved its value, no arguments against it, Sage or otherwise, will prevent its advance.

Exports of Electrical Material from New York.

The following exports of electrical material and machinery are from the port of New York for the week ending Jan. 31:—Argentine Republic—37 cases electrical material, $1,668; 14 cases electrical machinery, $1,238. Africa—2 packages electrical material, $551. Antwerp—22 packages electrical material, $1,935; 33 packages electrical machinery, $12,351. British possessions in Africa—14 cases electrical material, $2,328; 26 packages electrical machinery, $7,674. British West Indies—32 packages electrical material, $347. Brazil—187 packages electrical material, $4,022; 45 packages electrical machinery, $1,630. Cuba—67 packages electrical material $2,286; 2 cases electrical machinery, $122. Chili—23 packages electrical material, $1,200; 6 packages electrical material, $132. Dublin—55 cases electrical material, $9,256; 3 cases electrical machinery, $3,432; 2 cases electroplates $300. Central America—5 cases electrical machinery, $286. Glasgow—103 packages electrical machinery, $3,367. Havre—7 packages electrical material, $362. London—42 packages electrical material, $2,205; 137 cases electrical machinery, $8,445; 32 cases electrical machinery, $252. Liverpool—1 case electrical material, $50. Naples—2 cases electrical material, $275. Oporto—12 cases electrical material, $538. Peru—60 cases electrical material, $546. Southampton—13 packages electrical material, $486. United States of Colombia—2 cases electrical machinery, $100. Venezuela—200 packages electrical material, $725.

The Ugly Horseless Vehicles.

In all its picturesque ugliness the automobile is a boon and a blessing, says the "Scientific American." It looks like a hackney-coach with the delirium tremens, but it is a sober-minded, straightforward vehicle. We not only give it our respect but our admiration, for, with its big rubber wheels it gets over the ground in a velvety sort of way and reaches its destination without becoming tired. The gentle horse has had his day and will soon be a relic of the past, except for purposes of pleasure. He has done his duty well, but he roused our sympathies in slippery weather and proved that four feet are not enough to stand on when the streets are icy. All hail to the automobile, and may some gifted genius soon arrive who will whip it into shape and make it presentable! All things are possible, even a good-looking horseless carriage.

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MISCELLANEOUS

Latest Progress in the Application of Storage Batteries.[1]—II.

BY JOSEPH APPLETON.

CHICAGO EDISON INSTALLATION.—This installation is particularly interesting as being the largest individual battery ever installed for a lighting station. The Chicago Edison Company had their original power plant in Adams street, which is practically in the centre of the downtown section of Chicago. This plant was abandoned in August of 1894, just six years after it was started up, and a large, modern power house was erected on the river front at Harrison street.

Their maximum load in 1897 was 44,000 amperes, or 8,000 electric h. p., and early in 1898 it was estimated that the maximum winter load for that year on the downtown system would be in the neighborhood of 55,000 amperes. In fact, the point had been reached when new investment, either in generating capacity or battery, had to be made.

The peak of their load during the winter, as will be seen from the accompanying curve, Fig. 3, occurs about 4.45 p. m., and lasts from 45 minutes to one hour and a half. Their method of operating is as follows:

The current from the Harrison Street Station is transmitted over lines to the old Adams street building, being distributed over the network of mains from that point. The distance between Adams street and Harrison street is about 3,340 feet, and the tie lines between the two places have a capacity of 66,000,000 c. m. If additional generating capacity had been provided for the peak of 1898 it would have meant a corresponding increase in this tie line, but by installing batteries at Adams street, the centre of distribution, not only was the saving in generating capacity effected, but also in the tie line. The battery installed at Adams street consists of 166 cells, arranged 83 on each side of the three-wire system, and each cell contains 87 plates, 15½ inches by 32 inches. The containing cells or tanks are constructed of 2-inch ash, lined with 5-pound sheet lead. The dimensions of each cell are 9 inches wide, 6 feet 8 inches long and 4 feet high.

The weight of each cell is 6,200 pounds complete, and the total weight of the battery is, exclusive of copper conductors, 1,092,200 pounds. The battery is installed in the basement of the Adams street building.

The battery has a capacity of 22,400 ampere hours at the eight-hour rate, the maximum rate of discharge being 11,000 amperes for about 1¼ hours. Thirty of the 83 cells on each side of the three-wire system are end cells, and are connected to three end cell switches on each side, so that, if desired, the battery can discharge at three different pressures. These switches, shown in Fig. 4, have a capacity of about 3,000 amperes each, so that they will fully take care of the maximum discharge of the battery. The connections between end cells of the battery and these switches are made by copper conductors 6 inches by ½ inch, and the main connection of the battery, of copper conductors, 6 inches by 1 inch, giving a sectional area of six square inches.

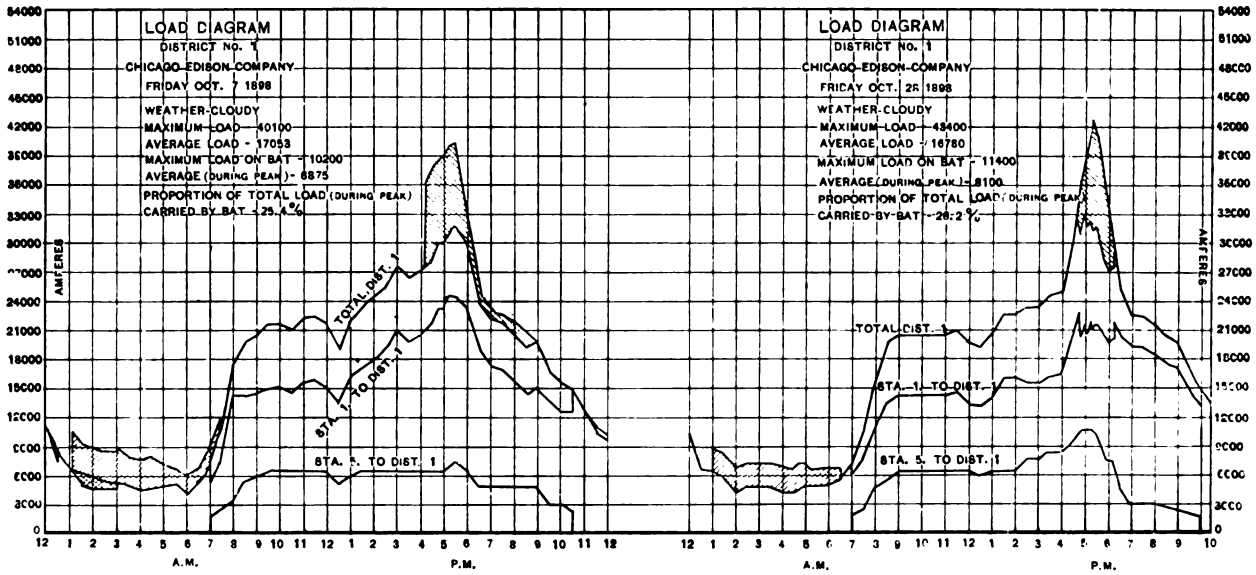

FIG. 3.—LOAD DIAGRAMS OF THE CHICAGO EDISON COMPANY.

The end cell switches are located near the battery, and are operated from the distributing switchboard room by small electric motors. The cut in Fig. 4 shows one of these switches with the motor control. It is so arranged that when it is desired to cut in or out any number of cells, it is simply necessary for the switchboard attendant to press a little button, which will operate the motor and move the switch over from one contact to the next, the switch stopping automatically when it is in a proper position on any contact. Indicators are provided on the switchboard to show the attendant how many cells are in circuit on each switch.

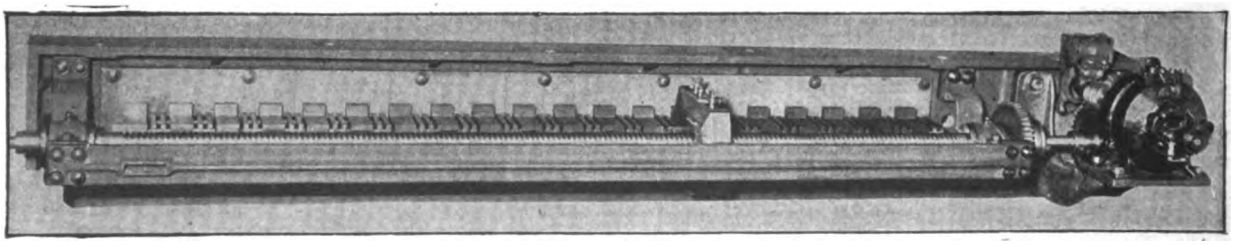

FIG. 4.—END CELL REGULATING SWITCH WITH MOTOR CONTROL.

By discharging this battery at two or three different pressures, it is possible to load the feeders up to their full capacity, a thing which was impossible when the distribution was made from one pressure, as was previously the case.

Both the short and long feeders running from the distributing board at Adams street can be supplied with the necessary volt-

[1]Abstract of paper read before the N. Y. Elec. Society.

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age 120 to 140 volts, to utilize their full capacity, making a large saving in the case of the feeders. The charging of this battery is done over the tie line from the Harrison Street Station, no boosters being used.

When charging, a pair of generators in the Harrison Street Station are disconnected from the system, and connected to a portion of the tie line for charging the battery, the necessary voltage being obtained by speeding up the generator. This method obviates the investment required for boosters, and makes the efficiency of the battery higher, as the generators are always run at their full capacity. Fig. 3 shows the load curve for two days in the winter, and it will be seen that the battery carries about 11,000 amperes during the peak of the load, or about 26 per cent. of the total load. The advantages of batteries under these conditions will be readily seen, as they will take care of the maximum load during the short time it occurs, and will increase the load on the generators during the remainder of the time when they have to be charged.

The battery is used, in addition to carrying the peak of the load, for maintaining a constant pressure on the system, and relieves the switchboard attendants at the generating station from constantly watching and regulating the pressure, the battery taking care of any fluctuations automatically.

In a lighting and power station such as this, the maximum load occurs for only a very short period during the year. In one station I know of, 50 per cent. of their investment is generating plant and underground conductors; which is only used for 154 hours during the year. This statement may seem astonishing, but will be found to apply to many such stations. Where these conditions exist it will readily be seen how great are the advantage of storage batteries as auxiliaries. Their cost per kilowatt of output for short periods such as these peaks, is less than the generating machinery which would have to be provided if they were not used, in addition to which there are other ways in which they prove advantageous in the operation of the plant.

The application of storage batteries to such stations, such as this, can be made in two ways, viz., at the main power house or in sub-stations. Each method has its own advantages, and should be determined in each case by the conditions which exist.

When batteries are placed in sub-stations they will relieve the generating plants of the maximum load as just described, and also effect a large saving in the underground system of conductors, as, at the time of maximum load, the conductors between the main generating station and the sub-stations are relieved of that portion of the load, which is carried by the batteries and distributed from the sub-stations.

The use of large water powers as a motive power for generating stations from which electrical energy is transmitted and distributed over extended areas is growing. Take for example the Niagara and other plants. In connection with such installations storage batteries play a very important part.

The power from such a plant is largely sold for manufacturing purposes, and is charged for at so much per horse power per annum, the power being available 24 hours per day, while the mills and factories using this power do not usually run for more than ten hours per day. Therefore, a man who requires a maximum of 100 horse power for ten hours a day, or 1,000 horse power hours, really has to pay for 2,400 horse power hours, while he uses only 1,000, and probably less, for the average, rarely, if ever, exceeds 70 per cent. of the maximum.

With a storage battery capable of supplying 50 horse power for ten hours, or 500 horse power hours he need only pay for one-half the amount or 50 horse power for 24 hours, as the battery will furnish the remainder, and can be charged during the fourteen hours he is not using the power. In addition to this, the battery will take care of any fluctuation above the average, and enable the man to buy the average amount of power he requires, instead of the maximum.

Such an installation has been made by the Buffalo Street Railway Company. Before describing this installation I would like to mention the different methods of installing storage batteries in connection with railway plants. These may be divided into two classes.

First: Where the battery is installed at the power house to take the care of the peak of the load, and the fluctuation of the generators.

Second: Where the battery is installed at the end of a long feeder to keep up the pressure at that point, and to obviate the necessity of sending the maximum amount of current over the long feeders from the power house.

THE BUFFALO STREET RAILWAY CO.'S PLANT.—This is of the first class and is especially interesting inasmuch as it is operated in connection with the Niagara Falls power. They operate practically all the cars within the city limits, and have a steam plant capable of delivering 7,000 electrical horse power, in addition to which they take 2,000 horse power from the Niagara Falls power, this current being transmitted in the form of high tension alternating current from the Niagara Falls to the power house, and being then transformed by rotary converters to the ordinary 550 volt direct current.

The storage battery is installed at the main power house and is connected directly in parallel with the steam plant and rotary converters.

When a storage battery is installed at the power house, and is connected directly in parallel with the generators on the busbars, some means have to be provided for regulating the voltage of the battery to suit the generators. As you know, railroad generators are overcompounded, the voltage rising as the load increases, while with the storage battery the reverse is the case, the voltage decreasing as the discharge increases. In order to make the battery work properly in parallel with generators of this type and take the fluctuations of the load, keeping the generators constantly loaded, some means of compounding the battery has to be adopted. This is done by using a compound wound booster in series with the battery, which is so designed as to increase its voltage in proportion to the increase of load, thereby enabling it to take its proper share and keep the load on the generators constant.

The battery discharges during the morning and evening peak, and is charged between times, and also at night from the Niagara Falls power.

By the aid of the battery they are enabled to make very much more use of the Niagara Falls power. Before they installed the battery they were only able to shut down their steam plant from 11.30 p. m. until 5 a. m., during which time the rotary converters carried the entire load, which averaged about 600 horse power, while they were paying for 2,000 horse power. With the aid of the battery they are enabled to shut down their steam plant from 7 p. m. to 7 a. m., and about eighteen hours on Sunday. In addition to this they are enabled to utilize very much more of the Niagara power.

SOUTH SIDE ELEVATED, CHICAGO.—An illustration of the second method of using storage batteries for railroad work is seen in the case of the battery installation of the South Side Elevated Company of Chicago. This company operates an elevated railroad about nine miles long, all their trains being equipped with the Sprague multiple unit system. The power house is located approximately at the centre, and the two storage batteries near each end of the line, which are connected directly across the system without a booster. The charge and discharge of these batteries is controlled by the drop over the feeders from the power house to the batteries, this drop varying according to the load on the system from ten to eighty volts. When the load on the system is light, the drop in the feeders is small, and there is voltage enough to charge the battery. When the load becomes heavy, the drop on the feeders is increased; this consequently causes the batteries to discharge into the line. The method of operating is entirely automatic, the batteries discharging at times of heavy loads, and charging at time of light load, thereby keeping the load on the generating station practically constant. In each of the two battery rooms are installed 248 cells having a capacity of 1,000 horse power when discharging at the hour rate. The following curves show the result which the batteries have had on their generating plant.

The first curve, Fig. 5, shows the load on the generators when they were operating the entire system without batteries.

The second curve shows the load on the generators under the same conditions with the batteries in use.

The other two curves show the operation of the battery at this time, which is the time of the heaviest load or the "peak" of the system.

It will be noticed from these curves that when the power house was operating without the battery during the peak of the load the maximum load was 7,500 amperes, with sudden fluctuations of 5,300 amperes, while with the batteries in operation the maximum load at the power house under exactly the same conditions was 5,700 amperes, and the fluctuations only 2,000 amperes. Thus, the batteries had increased the capacity of the

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power house by about 2,000 amperes, and steadied the load on the generators to the extent of nearly 3,000 amperes.

Those acquainted with the operation of railway plants will appreciate such results. The way in which a battery operates under such conditions and takes up the fluctuations automatically, is plainly seen by the curves, showing the readings on the annunciators in the battery circuit.

Each battery is connected to the power house by two special feeders in addition to the general system of conductors, so that the proportion of charge and discharge can be regulated according to the conditions of the load.

If it is found that a battery is being discharged more than it is being charged, an extra feeder is connected between it and the power house, so that it will be relieved of a portion of the load. By this means a very complete control can be maintained of the battery from the power house, and the most efficient method of operation secured.

A battery installed at the end of a line in this way, not only increases the capacity of the power house and saves the investment in copper by making it only necessary to transmit over the feeders the average amount of current required, instead of the maximum; at the same time maintaining the proper voltage at the end of the line, thereby enabling the motors to run at the point of highest efficiency. Of course the line must be long enough to justify the use of a storage battery and to supply

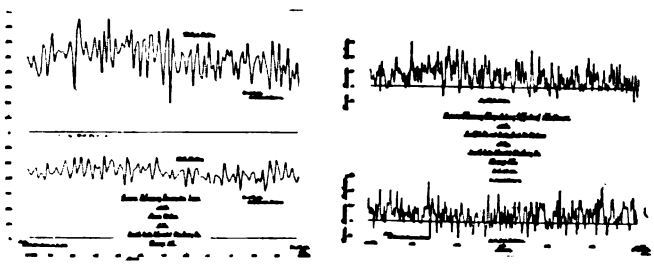

FIG. 5.—CURVES SHOWING REGULATING EFFECT OF BATTERIES, SOUTH SIDE ELEVATED RAILWAY COMPANY, CHICAGO.

sufficient drop in voltage over the feeders to make the battery operate automatically as the load varies.

A variation in voltage at the end of the line, between conditions of maximum load and minimum load of 10 per cent. is ample to make the battery self regulating, and take care of the fluctuating load without a booster. The following figures taken from a storage battery installation of this description installed some two years ago, will show the advantages from a commercial point of view.

The conditions were as follows: The length of this line at the end of which the battery was installed, was seven miles from the main power house, running into the suburbs of a large city. The increase of traffic on this line warranted its extension four miles further, making a total of eleven miles from the power house. When the extension was made, it was found that the feeders were quite inadequate to carry the increase of load, and it was necessary to provide additional power at the end of the line, either by laying additional feeders, installing a small power house at that point, or putting in a storage battery sub-station. Each method was carefully considered, and the following figures show the result: If additional feeders were laid of sufficient sectional area to provide the proper working voltage at the end of the line, the cost would have been $273,000, figuring on the basis of $1.00 per foot, laid for 1,000,000 c. m. feeders. This was of course prohibitive. The cost of a small power house of sufficient capacity to take care of the load in that section of 750 kilowatts would have been $85,000. The cost of a battery sub-station complete, including real estate, was $33,000, or a saving of $52,000 over that of the power plant.

The cost of operation has proved exceedingly satisfactory, showing a saving of some $1,350 per month, or $16,000 per annum over the cost of operating a power house of such a size. The cost of operation includes all attendance, taxes and depreciation and interest.

ONE DOLLAR was the award of Judge Gummere for the life of a boy run over by a car of the Consolidated Traction Co. in Jersey City. A jury has just given a verdict in the Supreme Circuit Court for $5,000.

American Representation at the Paris Exposition of 1900.[1]

BY HON. FERDINAND W. PECK,
Commissioner General.

WE are indeed grateful for this privilege, in the distinguished presence of the men who represent in such a marked degree the industrial life of our nation, to exploit the important work that has been committed to us by the representative of the people of this Republic—the President of the United States.

We realize that in presenting before this body our thoughts regarding the relation which our country should bear towards the great forthcoming Exposition, we are addressing those upon whom above any other class of citizens of our Republic, rests the responsibility of making that relation creditable to our nation in the eyes of the world and valuable to the vast commercial interests which we seek to advance.

We urge your earnest co-operation in our great national trust, which shall be administered without partiality or sectionalism, and we feel assured that it will be accorded to us, not only because your business interests are involved therein, but because your patriotism, your loyalty to the good name of our common country which is at stake, will induce you to aid us in presenting our wares to the 60,000,000 of people representing 500,000,000 of the inhabitants of the earth who are awaiting the part which the United States shall take in the great international peace contest about to be waged upon the other side of the Atlantic; for it will not be France only or Europe alone that will contemplate the display of our products in 1900, but also South America, China, Japan, our neighbors of Mexico and Canada, and the people of the entire world before whom we desire to submit our samples with the reasonable expectation that our manufacturers and producers may thereby stimulate and enhance their export trade, and at the same time represent the glorious progress of their nation.

Owing to the greatness of our country, which we were enabled to present upon a formal occasion during our recent mission in Paris, the French authorities conceded to us an increased exhibit space nearly fifty per cent. beyond the allotment which had been made, and which in the aggregate is larger than that of Germany or Great Britain. The sections of the United States will attract more visitors than those of other countries, owing to our unexampled development and present importance which have been heralded and impressed upon the peoples of other nations by our recent achievements which have made the whole world wonder and ponder. The booming of our guns in the Far East and our supremacy in the West Indies nearer home have startled all mankind, and they are now watching for our display of the arts of peace at Paris in 1900, when all nations will be keenly striving against each other for business expansion, though they meet as a world's fraternity. They ask: "What will the nation which has only recently reached across the globe—the rising giant of the new century—bring to the great feast when we sit at the table of our French host next year?" The crowds will come to see our machines, our means of transportation, our electrical displays, our agricultural resources. They will learn the varied utility of corn and our food products. They will see the displays from our mines and forests. They will know that we are not lacking in the methods of education and in genius and culture in the realm of fine arts. They will become impressed with the fact that the United States has made more progress in the nineteenth century in the development of her men, the development of thought and in achievements, than any other nation on the globe.

Now gentlemen of the National Manufacturers' Association, do you fully realize the greatness of your own country in a commercial sense in its relation to other nations? Do you realize that our population is about two and a half times that of France; that the value of the manufactured products of the United States is equal to one-third of that of the entire world; that our agricultural resources are equivalent to fully 40 per cent. of those of the whole earth; that in railway transportation our mileage is nearly 50 per cent. greater than that of all the nations of Europe; that in mining, our resources are far larger than those of all Europe; and that our gold product alone was one-third of that of the gold of the world; that one-half of our vast copper output is exported to Europe; that we are already

[1]Address delivered before the National Association of Manufacturers at the Cincinnati Convention, Jan. 24-28, 1899.

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exporting vast quantities of manufactured iron to Great Britain and Germany; that the aggregate wealth of the United States is 410,000,000,000 francs, which is greater than that of Russia, Austria, Italy and Spain combined, more than twice that of Europe, and 25 per cent. greater than even that of Great Britain, though the last named Kingdom enjoys more than double our foreign trade. It was such facts as these which we succeeded in impressing upon the minds of the officials of the French Republic that enabled us to secure the additional area for our exhibits. It was our country's marvelous progress and present importance that forced the concessions recently acquired.

It is foreign commerce that has made Great Britain the leading nation of the entire continent, and the internal prosperity of the United States and our marvelous facilities now existing to supply the markets of the world render correspondingly great the responsibility that rests upon the gentlemen here present representing the manufacturers and producers of the United States to make such a display at Paris as will aid us in promoting our exports, thus disposing of our surplus products and maintaining and increasing the welfare of all classes that constitute the citizenship of our Republic.

We have closed a year fraught with more consequences than any in American history, and have entered upon a period of unprecedented national expansion. Here, then, gentlemen, is a great opportunity offered by the coming event of the next year that will enable our commercial growth to keep pace with our geographical expansion.

Having now referred to the commercial benefits and the patriotic duty involved in the earnest interest and co-operation of our industrial people in the relation that the United States will bear to this Exposition of 1900, I will speak briefly of the importance of another most important element that must enter into our successful participation in that undertaking, and I take this opportunity to ask for your potential aid and influence in securing such additional appropriation by the Congress of the United States as is needed in order to achieve the results which every patriotic citizen of our country desires.

The original appropriation was made last June, when we were emerging from a struggle with a foreign foe and when the allotment of space, which was then regarded as final, was far less than the present aggregate. Now that peace has been established and the Commissioner General appointed under that act has been able during his recent mission abroad to secure a large increase of area for our exhibits, besides sites for certain buildings which must be erected in order to maintain our national honor and in order to stand on at least a uniform basis with other great nations, it is manifest that an additional sum will be needed in order that our part in the great event may be worthy of the American Republic.

A few comparisons with other nations in this regard may interest you. Germany has about 150,000 square feet of space, and has already appropriated $1,250,000. Austria has secured 110,000 square feet of space and appropriated $550,000; Hungary, 100,000 square feet and contributed $630,000; Italy, 120,000 square feet and appropriated $600,000; Japan, 50,000 square feet with an appropriation of $625,000. The great United States of America has secured 220,000 square feet, besides a large area at Vincennes, to provide for which we are now limited to $650,000; or, in other words, other great nations have provided a sum for their exhibits averaging nearly three times as much per square foot as has the United States, and most of these countries are upon the very borders of France, while we have an ocean expanse of 3,000 miles to cross, and a great continent lying between the Atlantic and Pacific from which to collect and select exhibits involving a large corps of assistants and heavy traveling expenses. I submit therefore, is there any answer to this argument of comparison?

We ascertained when we reached Paris that the great nations of the earth were contemplating the erection of national buildings as a gathering place for their people and had secured sites for the same adjoining each other upon the embankment of the Seine, and that some of them—notably Great Britain, Austria, Italy and Belgium, Holland, Turkey and Spain amongst the rest—were building these national homes for their citizens in the midst of this foreign exposition, and our United States of America—greatest of them all—was conspicuous by its absence. We appealed, we used every diplomatic means, and finally insisted; and after many weeks of delay, the French authorities crowded other nations together in the restricted area to make room for the great American Republic, which is now reaching across the globe to Oriental seas over the heads of those older nations. We have now provided for an American gateway at a special river landing to the French Exposition through our own American Building, where American citizens can find an American home, American guides, American post office, American ice-water, American comfort, amidst American environment—where they can meet their American friends from Ohio and from every State of the American Republic from Maine to California. Will this great national organization represented here to-day insist that our Congress shall include in the needed sums an amount sufficient to enable our country to have its national structure included with this group, or shall our thousands of citizens in 1900 cross the ocean to find themselves without an American home, while gazing in shame and mortification at the flags of all other nations heralding a welcome to their peoples?

Our honored President of the United States in his recent annual message to Congress has recommended an increased appropriation. This was prepared before the present allotment of space was known and without the knowledge of the demands upon us for construction of a national building or annexes for our exhibits. I take the liberty of calling your attention to that portion of his message to Congress, which reads as follows: "In my judgment the recommendation of the Commissioner-General will call for your early consideration, especially as regards an increase of the appropriation, so that not only may the assigned space be fully taken up by the best possible exhibitor in every class, but the preparation and installation must be on so perfect a scale as to rank among the first in that unparalleled competition of artistic and inventive production, and thus counterbalance the disadvantages with which we start as compared with other countries, whose appropriations are on a more generous scale and whose preparations are in a state of much greater forwardness than our own. Where our artists have the admitted capacity to excel, where our inventive genius has initiated many of the grandest discoveries of these later days of the century, and where the native resources of our land are as limitless as they are valuable to supply the world's demands, it is our province, as it should be our earnest care, to lead in the march of human progress and not rest content with any secondary place. Moreover, if this be due to ourselves, it is no less due to the great French nation, whose guests we become and which has in so many ways testified its wishes and hope that our participation shall befit the place the two peoples have won in the field of universal development."

Will not the gentlemen of this great organization of manufacturers stand by us and lend their powerful assistance in demanding of the United States Congress the sum that is absolutely essential in order that we may maintain our pledges to the French nation, which we were obliged to make in order to secure the concessions made; and also in order that we may for the first time in our history be represented at a foreign exposition in a manner that will bring joy and prosperity to those who represent the business interests of the nation, and above all in a manner that shall fix the eyes of the world in wonder, enhance our patriotism, and call forth our gratitude to the Almighty that our agricultural and commercial greatness makes possible such a display?

The American Republic has in one hundred years enriched the history of the world beyond all other nations. Our people have builded a vast monument in the highway of progress during the nineteenth century; and now as we approach the close of that century and pass into a new era, how grand it is that the great event of 1900 should furnish the opportunity to crown that monument in the brilliant metropolis upon the other side of the Atlantic in the presence of all the peoples of the earth, who will stand in admiration, applaud our greatness and recognize our destiny. A nation's character, a nation's industry and a nation's thrift represent the power that lifts this crown to cap our monument of a century's progress.

HOLYOKE, MASS. There is serious talk on the part of a number of moneyed Holyoke and Hartford business men of building an electric railroad between the two cities, and thus do away with the scheme to make the Connecticut River navigable between this city and Long Island Sound. It is estimated that the railroad can be built for $1,000,000, while the cost of opening the Connecticut River would be $2,000,000.

SAN FRANCISCO. A thief went the rounds lately "tapping" the boxes of the nickel-in-the-slot telephones.

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ELECTRIC LIGHTING.

Practical Data on Small Acetylene Lighting.

BY FREDERICK S. MERRILL.

REFERRING to your article regarding acetylene gas, in the issue of Jan. 19, the writer ventures to answer your correspondent's questions from data based on personal experience while recently investigating the acetylene business as a field for possible change of profession.

There are scores of acetylene generators on the market today, and most of them may be termed mere makeshifts, although much ingenuity has been displayed in improvising means to meet the rigid requirements of the Underwriters' Associations. The country has been flooded with these cheap "tin-can" generators, and, as a rule, every hardware dealer or similar inexperienced person is the local agent for some acetylene generator. He interprets the manufacturer's catalogue or circular most liberally, and is generally ready to promise the most wonderful results and astounding economy. For practical use it is not possible to obtain an average production of greater than 4½ cubic feet of acetylene per pound of carbide, which, at the ruling price of $90 per ton in small packages, such as the householder or storekeeper would require, makes the cost of the gas $10 per 1,000 cubic feet. The illuminating value of this 1,000 cubic feet of acetylene is 48,000 candle-power hours, equivalent to 3,000 lamp hours in the incandescent system, which, at 17 cents per 1,000 watts, allowing 55 watts per 16 c. p. lamp, would cost $28.05. From these figures the use of acetylene readily appears advantageous, and, adding to this the independence from the lighting station and its operating hours, the largely increased illumination due to greater diffusion of the light, and the ability to distinguish all colors in their true value (a valuable feature in dry goods stores), the merchant is not to be censured for considering the subject.

Assuming the conditions given in your inquiry, viz., a store now using 20 lamps of 16 c. p. each, to light these premises about 12 gas jets would be required, each jet consuming ½ cubic foot per hour. Just at this point the greatest mistake is daily being made. The agent sees listed in his catalogue a generator of 12 lights capacity. He sells it to the storekeeper, and then the trouble begins, for none of the manufacturer's ratings on generators are intended for continuous service at full load. If used in this manner, hot gas must be produced, with a serious lowering of the efficiency of the generator and waste of carbide. The hot gas carries with it all the impurities and by-products, resulting in a premature and complete clogging of the minute openings in the gas tips. If the installation is in a store, practically all the lights will be extinguished at one time, in which case the moisture in the generator will make gas sufficient to more than fill the holder, and a large quantity will be wasted through the "blow off" device provided on good generators. If no such device was provided, the gas pressure might burst the generator.

Returning to the store and the 12 lights required, it is obvious from the above that a large generator is essential. A 30-light machine would give satisfaction, but a 40-light one would be much better for the purpose. Such a generator, set up, pipes installed, fixtures furnished, and everything complete would cost approximately $200. With carbide at $90 per ton, the 12 gas jets would cost 6 cents per hour to run. The candle power would be 288, against 320 (so-called) for 20 incandescents, but the store would be equally, if not better, lighted, as the rays of acetylene diffuse very widely. The attendance of the generator would be liberally taken at 15 minutes daily, but would require intelligent and careful manipulation, and, with most generators, the cleaning is an unpleasant task. The danger from such a plant would be almost nil. The pure gas cannot be exploded, and any leak is instantly obvious from the intensely penetrating odor of the gas. In a store, the fire risk from gas and the ordinary small town way of wiring, would be in favor of the gas decidedly. The electric light, to be sure, is more easily controlled, but the station may not be running on a dark day, and the gas is always available.

So far the problem of satisfactory gas tips for acetylene at a reasonable price is unsolved. In a store it would probably be desirable to renew the tips every 60 days on an average, but this expense is small.

From all the above it is apparent that the merchant requiring about 20 incandescents to light his business place may install an acetylene generator and obtain good lighting for the same money, or less money than he pays the electric lighting station. Few, however, probably would care to make the investment necessary or be bothered with the care of a generator, and in the present state of the acetylene gas business there seems to me small chance of a well-managed station losing many customers from this cause.

Maxim Method of Making Filaments for High Voltage Incandescent Lamps.

THE tendency at the present time in electric lighting is to use high voltages, and in order to meet the new requirements arising from this tendency it is necessary to increase the resistance of the lamp filaments as much as possible. This can only be done by making them extremely fine and long or by adding to the carbon of which they are composed some highly refractory non-conducting material. When such materials as carbid of silicon and carbid of boron are employed with the carbon they are liable to be volatilized by the electric current when the lamp is in use and to form a thin opalescent film on the inside of the glass globe of the lamp. Now diamond powder is not subject to this objection, as it will endure a very high temperature without being volatilized. Natural diamond powder—i. e., natural diamond reduced to powder—is, however, too expensive to be used for this purpose, even if made from the cheapest kind of stones that can be obtained; but according to an invention of Hiram S. Maxim, the number of which is 618,704 and which was granted to him on Jan. 31, 1899, he is able to manufacture a species of carbon which, while closely, if not completely, resembling the diamond, will be less expensive than natural diamonds. For this purpose it is necessary to employ an extremely great pressure and a high temperature, and an important feature of the invention has reference to the manner in which such great pressure and high temperature are obtained.

It is well known that carbonic acid or carbon dioxid (CO_2) may be retained in the liquid condition at a pressure of about from five hundred to six hundred pounds per square inch at ordinary temperatures, but that if it be converted into carbon monoxid the pressure required to confine it is very much greater. Mr. Maxim has taken advantage of this fact to obtain the high pressure and temperature required by placing in a strong tightly-closed vessel carbonic acid in the liquid or solid condition, together with carbon, preferably a hydrocarbon, such as gasolene. The carbonic acid and the hydrocarbon are then decomposed by subjecting them to the voltaic arc, the oxygen of the carbonic acid being thus caused to take up another measure of carbon and to be thereby converted from carbon dioxid into carbon monoxid. This decomposition, together with the rise in temperature, will produce the necessary pressure, the temperature of the carbon being at the same time raised so extremely high that the carbon in immediate contact with or contiguous to the electric conductors between which the voltaic arc is produced will be converted into a species of diamond scales which will scratch glass, while all the carbon will be very much modified. In some instances it may be necessary to continue the high temperature for a very long time in order to allow the carbon to crystallize out of the carbonaceous gases. Of course if the carbon or hydrocarbon be heated in carbonic acid alone very little effect would take place, as no very high pressure would be reached, whereas if a too large quantity of hydrocarbon be employed a loose, smutty, and soft deposit would be formed; but by having only a small excess of carbon—i. e., just sufficient to convert all the carbonic acid present into carbon monoxid, with a little free hydrocarbon remaining—then the crystallization may take place from the residuum of gases, and if the process be continued long enough diamond crystals or a species of diamond carbon may be formed. The diamond carbon instead of being of a very low resistance, which is peculiar to carbon whose temperature has been raised very high, will have imparted to it a high quality of electrical resistance. In fact, it may be so perfectly crystallized as to altogether prevent the passage of an electric current through it. This of course depends upon the length of time that the aforesaid treatment is

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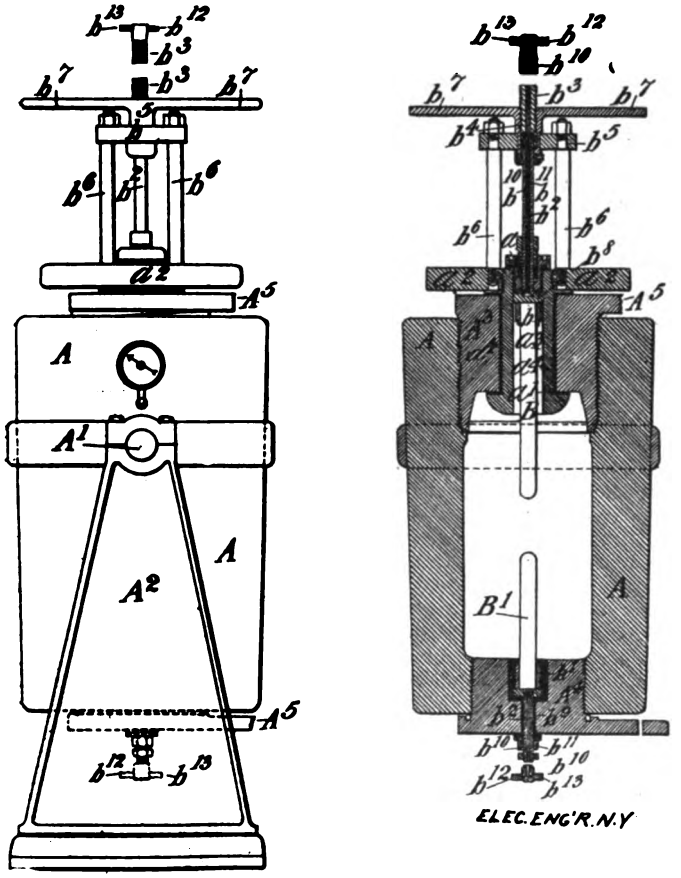
continued and the temperature employed during such treatment.

In some instances all the ingredients used for forming lamp filaments may be mixed and subjected to the high temperature and pressure, or the ingredients may be treated singly. It will thus be possible to so change the constitution of the carbon or other ingredients as to render them highly advantageous for the filaments of electric lamps. In any case the temperature to which they are subjected is higher than that to which they will be subjected in the lamp itself.

The carbon obtained or the ingredients treated by this method are afterward reduced to extremely fine powder, mixed with suitable vehicles—such as tar, pitch, or sugar—and then molded into filaments, which are "retorted" and "flashed" in the usual manner. It will be obvious from what has been stated that the electrical resistance of the filaments will be in proportion to the quantity of the diamond carbon employed in their manufacture.

Referring to Fig. 1 which is a side elevation, and Fig. 2 a vertical section, of one form of the apparatus for use in obtaining a high pressure and temperature according to the invention, A is a strong vessel of approximately cylindrical shape furnished with trunnions A' A', by which it is pivotally supported in a frame A^3. This vessel is preferably made of steel lined with suitable refractory material, such as bricks of compressed silica or compressed magnesia, to protect it from the



FIGS. 1 AND 2.—MAXIM'S APPARATUS FOR THE MANUFACTURE OF HIGH VOLTAGE INCANDESCENT LAMP FILAMENTS.

heat to which it is subjected internally when in use. The ends of the vessel are provided with strong detachable screw covers or screw stoppers A^2 A^4, each of which has a lever handle A^5 to enable it to be conveniently unscrewed when either of the said covers is required to be removed for the purpose of obtaining access to the interior of the vessel.

B B' are carbon pencils or electrodes mounted in metallic holders b b', forming part of hollow stems b^3, that extend through the aforesaid covers A^2 A^4. The carbon pencils are arranged coaxial with the vessel A, one of them being capable of longitudinal movement with respect to the other, so that the distance between their adjacent ends can be varied according to requirements. For this purpose the stem b^3 of the holder b passes through a stuffing box a, forming part of the plug piece a'. This stem b^3 is connected at its outer end with another stem b^4, which is screw-threaded and passes through a nut b^4. The nut is mounted in a cross piece b^5, so as to be capable of revolving without sliding, the cross piece b^5 being connected by bolts b^6 to a disk or bar a^3, which is screwed to the aforesaid plug piece a' and secures the latter to the cover A^2. The nut b^4 is furnished with lever handles b^7 to permit of its being revolved, while the stems b^3 b^3 are prevented from revolving by a feather b^8 on the carbon holder engaging with a longitudinal groove a^3 in the plug piece. This plug piece is insulated from the surrounding metal by suitable insulating material a^4. The other carbon pencil B' is carried by the stationary holder b', the stem b^3 of which passes through the screw plug A^4 and is insulated therefrom by insulating material b^9, such as mica or asbestos. In order to keep the carbon holders cool, Maxim makes the stem b^3 b^3 of the movable holder b and also the stem b^3 of the fixed holder b' hollow and arranges within them a central pipe or tube b^{10} with an annular space b^{11} around it. The extremities of the stems are provided with inlet and outlet nozzles b^{12} b^{13}, one of which communicates with the pipe b^{10} and the other with the annular space b^{11}. Cold water can thus be allowed to circulate through the carbon holders and the parts directly connected therewith.

In using the apparatus the carbon or hydrocarbon is placed within the vessel A, together with a quantity of carbonic acid, preferably in its solid or snow-like condition. The vessel is then hermetically sealed by tightly screwing on the screw stoppers, and the electric current is then allowed to pass between the carbon pencils. As the temperature rises by the heat generated by the electric current the solid carbonic acid in the presence of the carbon will be converted into carbon monoxid and a great pressure be thereby generated within the vessel, as shown above. The continuance of such high temperature and great pressure will convert the carbon into a very hard and crystalline condition, which after its removal from the vessel is crushed into fine powder for use with the carbon employed in the manufacture of the filaments, as already explained above.

SOCIETY & CLUB NOTES

Meeting of Special Committee of the Underwriters' National Electric Association to Revise Insulation Rules.[1]

MEETING was called to order by Wm. H. Merrill, Jr., chairman, electrician of the Electrical Bureau of the National Board of Fire Underwriters. Those present were: J. C. Forsyth, of the New York Board of Fire Underwriters; E. V. French, of the Associated Factory Mutual Fire Insurance Companies; William McDevitt, of the Fire Underwriters' Association of Philadelphia; A. M. Schoen, of the Southeastern Tariff Association; J. E. Cole, of the Boston Wire Department, and Edward B. Ellicott, city electrician of Chicago. Acting with the committee were: E. A. FitzGerald, of the Underwriters' Association of New York State; J. M. DeCamp, of the Suburban Underwriters' Association; Wm. S. Boyd, of the Chicago Underwriters' Association; M. L. Stern, of the Denver city electrical department; Edward M. Dexter, electrician, Milwaukee Board of Fire Underwriters; A. A. Pope, of the Edison Illuminating Company, New York; F. R. Jenkins, of the Chicago Edison Company; Prof. D. H. Jackson, of Wisconsin University, Madison, Wis.; R. L. Pierce, of the American Institute of Electrical Engineers, and Franklin H. Wentworth, Theodore Varney and Benjamin H. Glover, of the Electrical Bureau of the National Board of Fire Underwriters.

The chairman named Franklin H. Wentworth and Benjamin H. Glover, of the Electrical Bureau, as secretaries. Appointments confirmed.

On motion the thanks of the committee were tendered to those gentlemen attending who were not members of the original committee, and on further motion it was voted that they be considered auxiliary members of the committee with full privileges of the floor.

[1]The accompanying minutes were received by The Electrical Engineer on Feb. 4. The meeting took place at Chicago Jan. 9-11.

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The following was adopted to replace Rule 41, b, of the Code:

Metal Conduits with Lining of Insulating Material.

b. "The metal covering or pipe must be equal in strength to the ordinary commercial forms of gas pipe of the same size, and its thickness must be not less than that of standard gas pipe as shown by the following table:

Size inches.	Thickness of wall in inches.	Size inches.	Thickness of wall in inches
½	.109	1¼	.140
⅝	.111	1½	.145
¾	.113	2	.154
1	.134		

"An allowance of 2-100" for variation in manufacturing and loss of thickness by cleaning will be permitted."

The following amendment to Rule 41, j, was adopted: Rule and heading to read:

Unlined Metal Conduits.

j. "Plain iron or steel pipes of equal thickness and strengths specified for lined conduits in Rule 41, b, may be used as conduits provided their interior surfaces are smooth and free from burs; pipe to be galvanized, or the interior surfaces coated or enameled, to prevent oxidization, with some substance which will not soften so as to become sticky and prevent wire from being withdrawn from the pipe."

On motion Rule 8, e, was altered at written suggestion from American Institute of Electrical Engineers, to read, "Must not be run in series-multiple or multiple-series except on constant potential systems, and then only by special permission from inspection department having jurisdiction." Adjourned.

TUESDAY, JANUARY 10, 1899.

Both sessions were given up to discussion of experimental records of products from various factories manufacturing insulated wire. Representatives of the manufacturers were severally present during the time devoted to discussion of their products, answering the inquiries of the committee as to factory methods, original tests, etc. The following manufacturers of rubber covered wire and cables were represented: American Electrical Works, by Messrs. Remington and Donohue; Bishop Gutta Percha Company, by Mr. H. D. Reed; Eastern Electric Cable Co., by Mr. Eustis: Simplex Electric Company, by Messrs. Mason and Hixson; Canadian General Electric Company, by Mr. Watts; John A. Roeblings Sons' Company, by Messrs. Newbery and Sewell; Washburn & Moen Company, by Messrs. Pietzcker and Smith; Crefeld Electrical Works, by Messrs. Lockwood and Bibber; New York Insulated Wire Company, by R. E. Gallaher; Safety Insulated Wire and Cable Company, by Messrs. Clark & Austin; Indiana Rubber and Insulated Wire Company, by Messrs. Lucas and Lowe; W. R. Brixey (Kerite), by Geo. F. Porter; Okonite Company, Ltd., by Messrs. Manson and McKinlock; National India Rubber Company, by Mr. Hodgkinson; General Electric Company, by W. L. Clark; Standard Underground Cable Company, by Mr. Connot; Crescent Insulated Wire and Cable Company, by Mr. Murray; Phillips Insulated Wire Company, by letter; Alfred F. Moore, by letter.

WEDNESDAY, JANUARY 11, 1899.

The following representatives of the manufactures of wire acting with the committee appointed to consider the matter of wire coverings and standard specifications for the same were present at the opening of the meeting:

Messrs. Smith, of the Washburn & Moen Co.; Remington, of the American Electrical Works; Gallaher, of the New York Insulated Wire Co.; Clark, of the General Electric Co. and Canadian General Electric Co.; Clark, of the Safety Insulated Wire Co.; Manson, of the Okonite Co.; Hodgkinson, of the National India Rubber Co.; Reed, of the Bishop Co.; Eustis, of the Eastern Electric Cable Co.; Mason, of the Simplex Co.; Connor, of the Standard Underground Cable Co.; Bailey, of Roeblings Sons' Co.; Murray, of the Crescent Co., and Lucas, of the Indiana Rubber and Insulation Co.

The following specifications for rubber covered wires and cables were adopted:

40, a. Rubber covered copper for such conductors, except as hereinafter specified, must be thoroughly tinned and must never vary in diameter so as to be more than 2-1000 of an inch less than the specified size.

Insulation.

(1) Low Potential Systems. 300 volts or less.

Insulation for use on low potential systems must be of an approved compound and be of a thickness not less than that given in the following table for B. & S. gauge sizes.

From	18 to	16 inclusive	1/64
"	14 to	8 "	2/64
"	7 to	2 "	3/64
"	1 to	0000 "	4/64
"		to 500,000 C.M.	5/64
"		1000000 "	6/64
larger than		1000000 "	1/8

Measurements of insulating wall are to be made at the thinnest portion of the dielectric.

The completed coverings must show an insulation resistance of at least 100 megohms per mile during thirty days immersion in water at 70 degrees F.

Each foot of the completed covering must show a dielectric strength sufficient to resist throughout five minutes the application of an e. m. f. of 3,000 volts per 1-64 inch thickness of insulation under the following conditions:

The source of alternating e. m. f. shall be a transformer of at least 1 kilowatt capacity. The application of the e. m. f. shall first be made at 4,000 volts for five minutes and then the voltage increased by steps of not over 3,000 volts, each held for five minutes until the rupture of the insulation occurs. The tests for dielectric strength shall be made on a sample of wire which has been immersed for 72 hours in water, one foot of which is submerged in a conducting liquid held in a metal trough, one of the transformer terminals being connected to the copper of the wire and the other to the metal of the trough.

(2) High potential systems 300 to 600 volts.

The requirements shall conform to those for wires for low potential systems, i. e., 0—300 volts.

(3) High potential systems 600 to 3,000 volts.

The thickness of the insulating walls must not be less than those given in the following table for B. & S. sizes:

From 14 to 1 inclusive, 3-32".

No. 0, B. & S. to 500,000 C. M., inclusive, 3-32" and a tape and a braid or two braids.

Over 500,000 C. M., inclusive 4-32" and a tape and a braid or two braids.

The requirements shall conform to those for wires for low potential systems with the exception that an insulation resistance of not less than 300 megohms per mile shall be required.

(4) Extra high potential systems, 3,000 volts and over.

Wire for arc light circuits exceeding 3,000 volts potential shall have an insulating wall not less than 6-32" in thickness and shall withstand a breakdown test of at least 30,000 volts, and have an insulation of at least 500 megohms per mile.

The tests on this wire to be made under the same conditions as for low potential wires.

Note.—The committee on the whole concluded that the somewhat complex conditions existing with alternating currents exceeding 3,000 volts difference of potential made it inexpedient to specify general insulations for this use.

All of these insulations must be protected by a substantial braided covering properly saturated with a preservative compound and sufficiently strong to withstand all the abrasion likely to be met with in practice, and sufficiently elastic to permit all wires smaller than No. 7 B. & S. gauge to be bent around a cylinder with twice the diameter of the wire without injury to the braid.

40, e. Conduit wire must comply with the following specifications:

(1) For metal conduits having a lining of insulating material, single wires and all duplex, twin and concentric conductors must comply with section a of this rule and must have each conductor separately braided or taped and a substantial braid covering the whole.

(2) For unlined metal conduits, conductors must conform to the specifications given for lined conduits, and in addition have a second outer fibrous covering at least 1-32 of an inch in thickness, and sufficiently tenacious to withstand the abrasion of being hauled through the metal conduit.

The following was adopted by the joint meeting:

Resolved, All wires and cables designed to meet these specifications hereafter placed upon the market must be plainly tagged or marked as follows:

First—The maximum voltage at which the wire is designed to be used.

Second—The words "National Electrical Code Standard."

Third—Name of the manufacturing company and if desired,

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trade name of the wire.

Fourth—Month and year of the manufacture.

This resolution was passed by individual affirmative votes registered by all the manufacturers represented at this time, and the whole adopted by the meeting unanimously.

THURSDAY, JANUARY 12, 1899.

The following specifications for flexible cords were adopted:

All flexible cord must be made of stranded copper conductors, each strand to be not larger than No. 26 or smaller than No. 30 B. & S. gauge, and each stranded conductor must be covered by an approved insulation and protected from mechanical injury by a tough braided outer covering which shall also be slow burning.

A—Cord for Pendant Lamps.

In this class is to be included all flexible cord which under usual conditions hangs freely in air and which is not likely to be moved sufficiently to come in contact with surrounding objects.

(a) Each stranded conductor must have a carrying capacity equivalent to not less than a No. 18 B. & S. gauge.

(b) The covering of each stranded conductor must be made up as follows.

(1) A tight close wind of fine cotton.

(2) The insulation proper:

(a) This insulation must be solid, at least 1-32 of an inch thick and must show an insulation resistance of 50 megohms per mile throughout two weeks immersion in water at 70 degrees F. and stand the tests prescribed for low tension wires as far as they apply.

(b) Or must be at least 1-32 of an inch in thickness and composed of substantial, elastic slow burning materials which will suffer no damage at a temperature of 250 degrees Fahr.

Note.—The latter covering must only be used in permanently dry places; the former in other places where cord is allowed, such as basements, cellars and locations having moist atmospheres.

3. The outer cover of silk or cotton.

This cover should be so put on and sealed in place that when cut it will not fray out.

All cotton to be used on the cord should be impregnated with a flame-proof paint which will not have an injurious effect on the insulation.

B—Cord for Portables.

In this class is included all cord used on portable lamps, small portable motors, etc.

Flexible cord for portable use must conform to requirements 2 a for pendant cord and in addition be provided with a reinforcing cover especially designed to withstand the abrasion it will be subject to in the uses to which it is to be put.

C—Cord for Portable Heating Apparatus, Such as Irons, etc.

1. A tight, close wind of fine cotton.
2. Thin layer of rubber about 1-100 inch thick, or other cement—in material.
3. Layer of asbestos insulation at least 3-64 inch thick.
4. Stout braid of cotton.
5. Outer reinforcing cover.

This cover to be especially designed to withstand abrasion.

Note.—This cord is in no sense waterproof, the thin layer of rubber being specified in order that it may serve merely as a seal to help hold in place the fine cotton and asbestos, and it should be so put on as to accomplish this.

Amendment to Rule 24, t: When from the nature of the case it is impossible to place concealed wiring on non-combustible, insulating supports of glass or porcelain an approved armored cable (single or twin conductors, see Rule 40 f), may be used if it is installed without joints between outlets and the cable armor properly enters all fittings and is rigidly secured in place; or, if the wires are not exposed to moisture they may be fished on the loop system if separately encased throughout in approved flexible tubing or conduits. Passed.

Rule 40, f.—Armored Cable—The armor of such cables must be at least equal in thickness and of equal strength to resist penetration by nails, etc., as the armor of metal coverings of metal conduits (see Rule 41, b.).

The conductors in same, single wire or twin conductors, must have an insulating covering as required by section "a" of Rule 40, any filler used must be impregnated with a moisture repellant, and the whole must have a separate exterior covering of insulating material at least 1-32 of an inch in thickness conforming to the insulation standard given in Rule 40, a, and covered with a substantial braid. Passed.

Rule 16. Heading to read: "Below is a table showing the allowable carrying capacity of wires and cables of 98 per cent. conductivity according to the standard adopted by the American Institute of Electrical Engineers." Adopted.

Rule 24, g. Change "weatherproof" to "slow burning weatherproof." Adopted.

Rule 40, b.—1—Slow-Burning Weatherproof.

This character of insulation on wires shall consist of two coatings, the inner one to be fireproof in character, the outer to be weatherproof. Wire with this insulation must conform to, or be in excess of the measurements given in the following table which shows standard thickness of insulating walls for standard wires and cables.

Size B. & S.	Thickness of wall of Insul. Fireproof coat.	Weatherproof coat.	Total outside diameter. In mils.	In 32ds ap.
18	.042	.015	.154	5
16	.042	.020	.175	5½
14	.042	.020	.188	6
12	.042	.020	.205	6½
10	.050	.029	.260	8½
8	.050	.029	.286	9
6	.050	.029	.320	10½
5	.050	.029	.340	11
4	.054	.029	.370	12
3	.054	.029	.395	12½
2	.070	.029	.455	14½
1	.070	.038	.505	16
0	.110	.048	.641	20½
00	.110	.057	.699	22½
000	.110	.057	.744	24
0000	.110	.057	.794	25½

The inner or fireproof coat to be layers of cotton or other thread, the outer one of which must be braided. All the interstices of these layers are to be filled with the fireproofing compound. This is to be material whose solid constituent is not susceptible to moisture, and which will not burn even when ground in an oxidizable oil, making a compound which while proof against fire and moisture, at the same time has considerable elasticity, and which when dry will suffer no change at a temperature of 250 degrees F. and which will not burn at even higher temperature.

The weatherproof coat to be a stout braiding thoroughly saturated with a dense moisture-proof compound thoroughly slicked down, applied in such manner as to drive any atmospheric moisture from the cotton braiding, thereby securing a covering to a great degree waterproof and of high insulating power. This compound to retain its elasticity at zero F. and not to melt at 180 degrees F.

2.—Slow Burning.

This wire shall be the same as the "Slowburning Weatherproof," except that the outer braiding shall be impregnated with a fireproofing compound similar to that required for the interior layers and with the outer surface finished smooth and hard.

Note.—This "slowburning" wire shall only be used with special permission of the inspection department having jurisdiction.

3.—Weatherproof Line Wire.

The insulating covering shall consist of at least three braids thoroughly impregnated with a dense moisture repellant which will not melt at a temperature lower than 125 degrees F. The thickness of insulation shall be not less than 1-16 inch for No. 8 wire and smaller, and for all others not less than 3-32 inch. The outer surface shall be thoroughly slicked down. Adopted subject to revision. W. H. Merrill, Jr., chairman; J. C. Forsyth, New York Board of Fire Underwriters; Wm. McDevitt, Philadelphia Fire Underwriters; A. M. Schoen, Southeastern Tariff Association; J. E. Cole, Wire Department, Boston; Edward B. Ellicott, City Electrician, Chicago; E. V. French, Factory Mutual Fire Insurance Companies; Franklin H. Wentworth, Benjamin, H. Glover, Secretaries.

MR. C. J. GLIDDEN states that the new interest in the Michigan Telephone Co. will spend a large amount on new work. Detroit alone is to have five new exchanges, each costing about $50,000, exclusive of the real estate, and using the common battery system.

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Automobiles and the N. Y. Electrical Society.

Mr. G. H. Guy, secretary of the New York Electrical Society, has arranged another of its famous "visiting" meetings, for Tuesday evening, Feb. 14. This time, a trip will be made to the plant and headquarters of the Electric Vehicle Company, where that novel and intensely interesting branch of electrical work will be shown in full operation. Mr. G. H. Condict, the electrical engineer, will explain features of the modus operandi, and all departments will be thrown open. A collation will be served and members will be at liberty to bring ladies. The opportunity thus presented to study a new art is one of rare attractiveness.

Meeting of Independent Telephone Interests in Indiana.

The Indiana Telephone Association, made up of independent companies throughout the State, held its annual meeting at Indianapolis on Jan. 18. There were more than fifty companies represented. The business before the meeting was of a routine nature, but there was general discussion as to the outlook of the independent organizations in Indiana. Many of the members said their companies are growing in strength, and that they are widening the use of the telephone to a remarkable degree by giving cheap, efficient service.

Two of the independent exchanges, one at Noblesville and the other at Newcastle, have been bought in by the Central Union Co., but members of the association say they do not expect any other desertions from their ranks. The members express confidence in the movement to establish an independent telephone system in Indianapolis, which will in time be connected with all the independent exchanges in the State. It was said that material has already been purchased with which to connect all the county seats within fifty miles with the Indianapolis system.

The following officers were elected: President, E. H. Andress, of Lafayette; vice-president, A. A. Reynolds, of Crawfordsville; secretary and treasurer, H. B. Gates, of Indianapolis. In addition to these officers the following others were named, all to compose the Executive Committee: G. W. Beers, of Ft. Wayne; John McGregor, of Madison; A. F. Ramsey, of Crawfordsville; Hugh Dougherty, of Bluffton.

Dr. A. E. Kennelly Before McGill University On Ocean Telegraphs.

DR. A. E. KENNELLY, president of the American Institute of Electrical Engineers, appeared last week by invitation before McGill University, Montreal, and delivered four lectures on the subject of submarine cable telegraphy. The lectures were very interesting, and were fully attended not only by the students, but by electrical people and others. We give below a very brief abstract of the lectures:

The history of submarine cable telegraphy is replete with interest, not only to the student of electromagnetics, but also to the student of sociology. Its annals indicate the immense amount of labor which has had to be expended by a large number of men in the best years of their lives' work, in developing conjointly the knowledge and experience which now enables us to set geographical time and space at defiance. Practically all of this work has been accomplished during the last half of the century which is now about to close. The first submarine cable stretched timidly across the Straits of Dover about the year 1850, consisting of but a single copper wire, insulated with gutta percha. It had no mechanical protection of any kind. Although the cable lasted but a few hours, being destroyed either by the violence of the elements or the hook of an unkind fisherman, it demonstrated its electrical capabilities, and paved the way for greater successes in the years to come.

It was not long before shallow water cables spread themselves around the shores of the Mediterranean, and in 1859 the first cable bridged the depths of the Atlantic. This was, indeed, a triumph of electrical engineering at that time, but the triumph was short lived, since the cable died a natural death in a few weeks' time. It was replaced, however, by a far better cable, in 1866, the experience of the earlier trial having come to fruition, and since that time Europe and America have never been beyond speaking distance.

At the present time there are some 150,000 miles of cable laid throughout the world, and a fleet of more than thirty telegraph ships is employed to minister to their needs. Although this length of cable would be sufficient to girdle the world some six times, yet the actual girdle is incomplete at present, at the Pacific Ocean, but it is now confidently expected that ere long this gap will be completed by a cable from the western coast of America to China or Japan. The amount of the capital which has been expended in the enterprise of cable laying will be evident from the fact that cable costs, roughly, about one thousand dollars per mile.

Enormous improvements have taken place in the speed of signaling or telegraphing through cables, since the ocean was first spanned, a great great deal in this direction being due to the inventive skill of Lord Kelvin. The mirror galvanometer instrument, which is so valuable an adjunct in the electrical laboratory, has been yet more valuable to the electrical fraternity in the operating room, as a commercial signaling instrument, while the siphon recorder of later date has caught the fitful flickerings of the beams of light, and has left their record traced upon a moving band of paper.

There is no difficulty in laying a cable anywhere, but there is a considerable difficulty in laying a cable in such a manner as to minimize the risk of its fracture after being laid. It is a matter of experience that wherever a cable rests upon a rock it will break, and its rupture is only a question of attrition and time. Those who build upon rock, so far as cables are concerned, build to their destruction, while only those who build upon sand can expect dividends. The course on which a cable is to be laid should be thoroughly investigated beforehand by a ship, which makes a zig-zag path over the course, and sounds at frequent intervals, so as to insure the provision of a smooth and soft bed, on which the cable shall be laid to rest, otherwise its slumbers will be interrupted by the rude shocks of rupture.

The size of a cable, and therefore to some extent its cost per mile varies with the depth of water and the nature of the bottom. In deep water a cable is made slender and light, in shallow water it is made of relatively great weight and diameter, with large protecting steel wires to resist attrition.

The speed of signaling does not become any serious conideration until a cable is several hundreds of miles in length. In other words, rapid speed of hand signaling can be obtained over almost any kind of practical submarine cable up to a length of several hundred miles, but after a length of, say, five hundred miles has been passed, it is necessary to employ delicate apparatus. With long cables it is necessary to employ a comparatively large size of copper wire or strand conductor and insulating gutta percha envelope.

There is scarcely any series of engineering operations which has a greater fascination or possesses more romantic interest than submarine telegraphy, in the picking up or repairing of cables. It is governed largely by time and tide and weather, and its fortunes are determined by a great variety of circumstances. Nevertheless cables have been successfully repaired in the deepest water, to which they have yet been committed. The expense of repairs in deep water, say in two miles of water, is naturally much greater, as a rule, than the expense of repairs effected in shallow water, while in some cases very shallow water repairs may be effected in a small boat or sailing yacht, at an expense that is relatively trivial.

University of Minnesota

On Jan. 26 Mr. Truman Hibbard, general manager of the Willow River Electric Light and Power Company of Hudson, Wisconsin, lectured at the University upon hydro-electric power plants, discussing certain features of three-phase and monocyclic systems for transmission and distribution purposes. Mr. Hibbard gave an interesting account of the power plants under his charge, showing the great flexibility of electrical apparatus. In two cases the power plant is reinforced by 600 volt direct current motors driven by generators at other water falls not far distant, in one case the distant wheel and generator being controlled from the principal station. A novel arrangement of secondaries was described, showing how a monocyclic gen-

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erator may be used in emergency to supply three-phase circuits from the regular transformers.

The electrical engineering museum at the University has recently been enriched by a number of pieces of station auxiliary apparatus secured from the Minneapolis General Electric Company, showing various steps in the development of lightning arresters and switchboard apparatus. A Heisler two-phase alternator recently secured from the Mankato Electric Light and Gas Company is being modified for experimental use, a system of switches being arranged to permit the easy and rapid changing from 1,000 volts to 100 volts at will, also enabling the use of both pressures at the same time.

Classified Digest of U. S. Electrical Patents Issued Jan. 24, 1898.

Alarms and Signals:—

ELECTRICAL SELECTIVE APPARATUS. John S. Thompson, of Chicago, Ill. No. 618,144. Filed Oct. 10, 1898. Adapted to the operation from a removed point of any desired one of a series of devices, such as typewriter keys, signals, and the like.

ELECTRICAL SIGNAL SYSTEM. John P. Buchanan, of Boston, Mass., assignor to the Union Switch & Signal Co., of Swissvale, Pa., No. 618,328. Filed June 10, 1893. Obviates the use of line wires by employing the track rails.

Batteries Secondary:—

SECONDARY BATTERY AND ELECTRIC LAMP. Walter A. Crowdus, of Chicago, Ill., No. 618,057. Filed Nov. 22, 1897. A "lead" type battery for use in connection with vehicle lamps.

SECONDARY BATTERY. Henri Dolter, of Lyons, France, No. 618,247. Filed April 23, 1898. Constituted by the juxtaposition of flanged walls of insulating material supporting the electrodes, arranged symmetrically on their surfaces, of which when the battery is put together the electrodes on the one wall occupy spaces between those on the other wall.

Dynamos and Motors:—

BEARING FOR ARMATURE SHAFTS OF ELECTRIC MOTORS. Herbert L. Parker and Charles R. Meston, of St. Louis, Mo., assignors to the Emerson Electric Manufacturing Company, of same place, No. 618,131. Filed July 9, 1898. Comprises a suitable frame for supporting an annular laminated field magnet core, a shaft fixed in the frame, a sleeve mounted on shaft, and a laminated armature core mounted on sleeve.

Miscellaneous:—

ELECTRICAL HAMMERING MACHINE. Thomas C. Robinson, Boston, Mass., reissue No. 11,710. Filed Nov. 22, 1897. A portable magazine tack driving machine. Details of construction.

Railways and Appliances:—

TRAIN TRACTION SYSTEM. Frank E. Case, of Schenectady, N. Y., assignor to the General Electric Company, of New York, No. 618,054. Filed June 22, 1898. A system of train control for electrically propelled vehicles employing a cable extending through the train, having connection boards at intervals, with a controlling device adapted to register with any one of the connection boards.

MAGNETIC CLOSER FOR ELECTRIC RAILWAYS. William Milt Brown, of Johnstown, Pa., assignor by mesne assignments to the Lorain Steel Company, of Ohio, No. 618,162. Filed Aug. 27, 1898. Details of construction.

CIRCUIT CLOSER FOR ELECTRIC RAILWAYS. George H. McFeaters, of Johnstown, Pa., assignor by mesne assignments to the Lorain Steel Company, of Ohio, No. 618,179. Filed Oct. 10, 1898. Comprises a cover having two sides of magnetizable material separated by a non-magnetizable centre, a fixed electrode below the centre, and in connection therewith a transversely-disposed armature with its ends beneath the magnetizable sides of the cover, an electrode carried by the centre of the armature, and connections from the armature to the source of electric supply.

TROLLEY STAND. Daniel Moyer, of Allentown, Pa., assignor of one-half to Frederick Conlin, of Bethlehem, Pa.. No. 618,231. Filed April 12, 1898. A pivoted pole-socket provided with a lever, a pivoted arm mounted to oscillate independently of the lever, a device carried by the lever to engage the arm when the lever is moved in one direction, and tension means for retaining the arm in one position.

Regulation:—

MOTOR SPEED CONTROLLER. Charles A. Dresser, of Chicago, Ill., assignor to G. A. Edward Kohler and Franklin W. Kohler, of same place, No. 618,071. Filed July 28, 1898. Means whereby a variable rheostat may be operated from a distant point to start and stop the motor and vary the speed.

ELECTRIC MOTOR CONTROL. William Milt Brown, of Johnstown, Pa., assignor to the Steel Motor Company, of Ohio, No. 618,163. Filed Oct. 7, 1898. A method of accelerating a plurality of motors consisting in changing the circuit relations between the motors, and during the period at which the motors are in a given circuit relation with each other decreasing the field strength and ohmic resistance of first one motor and then another motor.

Switches, Cut Outs, etc:—

AUTOMATIC SWITCH FOR DISTRIBUTION OF ELECTRICITY. John Hopkinson, of London, England, No. 618,175. Filed April 18, 1895. An automatic switch provided with a two-part movable, rigid brush having its two parts independently pivoted to equally distribute the contact pressure among four contact surfaces.

ELECTRIC SWITCH. William J. Ferguson, of Baltimore, Md., assignor of one-half to William G. H. Stump, of same place, No. 618,380. Filed Feb. 2, 1898. Combines the terminals of an electric circuit and mercury which may be mechanically shifted from one position to another, so that the mercury by contacting with the terminals will complete the circuit.

Telephones:—

SIGNAL FOR TELEPHONE SWITCHBOARDS. Charles E. Scribner, of Chicago, Ill., assignor to the Western Electric Company, of same place, No. 618,137. Filed Dec. 8, 1896. Comprises means for producing current in the line while the telephone is in use, a relay magnet in the line, a local circuit including a supervisory signal, a normally open shunt about the signal controlled by the contact points of the relay, and a magnet winding of the relay included in the shunt.

Healthy Conditions.

There was a quieting down of speculation in all the markets last week, but the results are in every way favorable to healthy conditions of trade and commerce, and reports from all quarters are most encouraging and hopeful. It is well that reactions and occasional checks should tone down an exuberance that would soon cross the danger line of gambling if let alone. Staples are now lower, but steadier, and the export trade resumes its vast proportions. In iron and steel the demand is tremendous, and the entire output of Lake Superior iron ore is sold one year ahead. Wholesale and retail trade reports point to general activity. Bank clearings for January were 51 per cent. higher than in 1898.

During the past week, 22,142 shares of Western Union exchanged hands, declining from 96¾ to 95½. On sales of 8,730 shares, General Electric was fairly steady around 111½. New York Edison stood at 196, but on 60,953 shares Metropolitan Street Railway jumped from 218 to 231. In Boston, American Bell Telephone closed 17½ points higher, and West End Railway was firm at 93.

Metal markets were in an excited state last week. Copper New York is actually 17 cents, or 6 cents higher than a year ago. Now is the time for aluminum. Heavy steel rail, Eastern mill, is $19. In pipe and tube there are large consolidations expected, strengthening the market.

MR. G. W. HEBARD, vice-president of the Westinghouse Electric and Manufacturing Company, is one of the incorporators of the new Rubber Goods Manufacturing Company, which has a capital of $25,000,000 of 7 per cent. cumulative preferred stock and $25,000,000 of common stock.

MR. HENRY KILLIAN has succeeded Mr. A. K. Bonta, as superintendent of the Hudson Electric Light Company, Hoboken, N. J.

MR. W. P. COOKE, JR., of the Port Arthur, Ont., Electric Street Railway and Light plant, owned by the city, has been elected an electric railway and light commissioner for three years.

MR. F. B. COREY, secretary of the Springfield, Mass., Elevator & Pump Co., has accepted a position as mechanical engineer with the Stilwell-Bierce & Smith-Vaile Co., of Dayton, O.

MR. W. S. DIX has resigned from the engineering staff of the Royal Electric Co., of Montreal to accept a position with Westinghouse, Church, Kerr & Co., of New York.

MR. W. F. D. CRANE, the well known electrical engineer, has joined the forces of the Electric Vehicle Co., of New York City, for whom he is carrying out some important work.

MR. C. T. YERKES said recently to the city council of Chicago that he did not believe that underground trolleys could be worked in that city, owing to its flatness and general physical conditions.

MR. BERTRAM HOPKINSON, son of the late Dr. John Hopkinson, has taken up his father's engineering practice in

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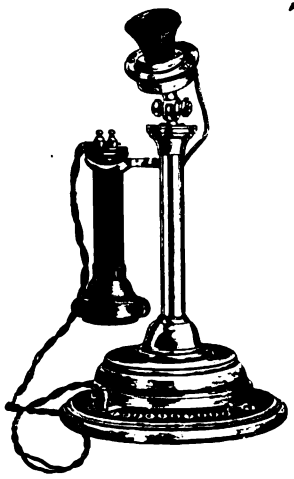
England, in partnership with his uncle and Mr. Talbot, so that the professional firm which has stood so high in public esteem will continue under very favorable conditions.

TRADE NOTES AND NOVELTIES

The "Viaduct" Interior Desk Telephone Set.

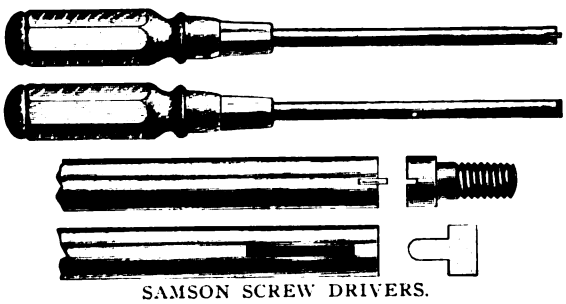


THE Viaduct Manufacturing Co., manufacturers of telephone apparatus, whose extensive works are located at the Relay Station, B. & O. R. R. between Baltimore and Washington, have recently placed on the market an interior desk telephone set, for which many advantages are claimed. The set, which can be installed with either a battery or magneto generator, is handsome in appearance, as can be gathered from the illustration, and is equipped with the standard long distance transmitter and receiver. A handy switch on the base enables one to connect the set with a number of other circuits, and should the switch be left on any one of the buttons, any other party will still be able to call you up. These and other admirable features are more completely explained in the company's catalogue, which will be sent to anyone on application.

Samson Screw Drivers.

THE Sawyer Tool Company, of Fitchburg, Mass., have recently placed on the market a line of screw drivers, illustrated below, which will be found invaluable for electrical work, such as putting up wires, fixtures, etc. Every one has had more or less experience with the ordinary driver, and have either mutilated their fingers, the screw or the object they were working on by having it slip at a time when they were applying the most pressure.

The advantages of this tool are as follows: First. It supports the blade up to the actual straining point. Second. It supports the head of the screw so that it will not wobble. A wood screw can be started by rapping the handle with the palm of the hand



SAMSON SCREW DRIVERS.

and screwed home without touching the screw after once in position. Third. The blade being parallel it bears as much at the bottom of the slot as it does at the outside, thus preventing a heavy burr on each side of the slot as is caused by the old fashioned tapered blade. Fourth. As the blades and shanks of drivers run in regular sizes corresponding to the average sizes of wood and machine screws, they do not wear and mar the screw as it would with the tapered and ill-fitting tools in common use. It would be economy for manufacturers to furnish them to their employees and save the time lost in repairing the tools. Fifth. If a blade is broken it can be quickly replaced by a new one. Extra blades are furnished with each tool. Prices for this handy and practical tool will be furnished on application and inquiries are invited.

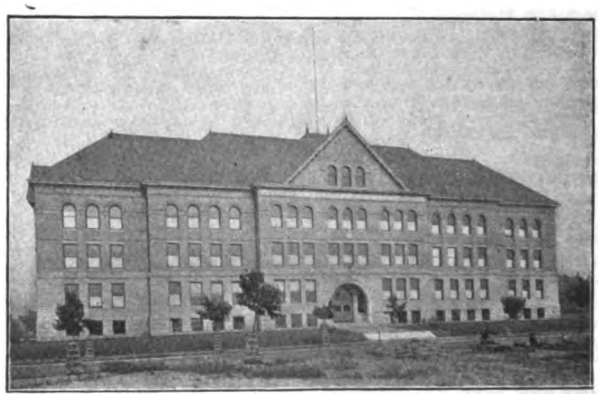
Applications of the Standard Electric Time System.

"STANDARD" ELECTRICALLY OPERATED CLOCK.

Of all the numerous and varied applications of the electric current there is perhaps none for which it is more logically adapted than the regulation of time and the sending of signals on account of its instantaneous transmission of signals absolutely within automatic or human control. It is an indisputable fact that upon the exactness of keeping business appointments and the correct timing of intervals depend the success of business enterprises, railroad trains, and even experimental researches. In fact the electrically operated or controlled clock has become so prominent a feature of everyday life that its study and manufacture has become quite an important branch of electrical engineering.

One of the foremost firms in this particular line is the Standard Electric Time Co., Waterbury, Conn., whose well-known system has won a high reputation on account of the satisfaction it has given wherever it has been installed.

Simple in its construction and perfect in its working, the cost of the system is low, out of all proportion with the convenience and time-saving it accomplishes. Aside from the original expense, a simple renewal of the battery once a year is all that is



HOLYOKE HIGH SCHOOL, EQUIPPED WITH THE STANDARD ELECTRIC TIME SYSTEM.

required. The master clock, or regulator, usually a plain and substantial looking timepiece, operates, sets and regulates any number of secondary clocks, made after various designs and finished in oak, ash, walnut, or other hard wood to match the interior finish. Under the head of secondary clocks should be mentioned the program clock, automatic in its action and especially designed for schools and institutions of learning, where the changing of classes is greatly facilitated by signals from electric bells which are rung by this clock.

The daily program is arranged by perforations in a paper dial, which revolves once each hour, and by contact through the perforation impulse is sent to the electric bells exactly on the second. Then there are the tower, corridor, mantel clocks, etc., all operated by the master clock, assuring exact time.

The clocks are in appearance most ordinary, lacking only the usual key hole. At regular intervals they are wound by the dry battery of a special type, concealed in the case of the regulator and appearing as one of its parts, which gives to the mainspring the advantage of even tension, most essential to the best time-keeping results.

The system by which these secondary clocks are kept continually in operation, resulting at once in uniformity and accuracy consists simply of a battery guage, indicator clock, alarm

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bell, cut-out switch and jumping key. At the closing of the circuit, on the 60th second of the minute, the battery is thrown in circuit with the system and shows its strength at that time. The indicator clock is for comparing the time on the secondary clocks with the master clock. The alarm bell is so arranged that it will ring when the battery needs attention, or if one of the wires should accidentally become disconnected or broken and the circuit opened. The cut-out switch is used for switching the secondary clocks on or off the master clock. The jumping key is for setting all the secondary clocks at one time.

In Connecticut alone there are not less than 100 systems of this kind in daily use, one of the most recent being the installation in the Holyoke High School, a large structure illustrated herewith. In the principal's office is the Standard Electric Time Co.'s fine self-winding regulator, fitted with their patented single circuit system for operating all secondary clocks throughout the building, also one of their three-circuit, minute interval program clocks for automatic ringing of all bells and gongs throughout the building. In each of the class and recitation rooms is a secondary clock, with 12-inch dial, in plain but neat cases, quartered oak. The assembly hall has a secondary clock, with 18-inch dial.

On the outside of the building, just over the entrance, is a large secondary clock, connected with this same system. The dial of this clock is 30 inches in diameter. Each entrance to the building and all the corridors have large gongs which are automatically rung from the program clock.

It required fifty clocks to equip this one building. It will readily be seen that with fifty ordinary clocks in such a building as this there would necessarily be fifty kinds of time, as no two clocks will show absolutely the same time. With this improved system fifty clocks show precisely the exact minute and time of day.

The company, whose president and superintendent is J. O. Lyman, and treasurer and very efficient general manager G. L. Riggs, will be pleased to send an illustrated catalogue and price list to anyone on application.

The Morgan Improved Outlet Bushing.

An investigation of electrical fires from recent reports has shown that in house wiring, a majority of the "trouble" has occurred at outlets. Usually the wires are brought out through ordinary bushings, and with such bushings a flimsy job is inevitable. This sort of a job seldom withstands the onslaughts of the lathers, plasterers and other artisans, but is usually found with the bushings hanging out or pushed back behind the laths.

The Morgan Outlet Bushing, illustrated in our advertising columns this week, is said to insure a safe and substantial job. After the bushing has once been nailed it cannot be moved from its position.

It is estimated that a saving of over 28 per cent. on the gross cost of each outlet can be effected by using this device at list price. The bushings are extra heavy and made of the best porcelain. Its dimensions are: Length, 3¼; inside diameter, ⅜; outside diameter, ¾ inches.

For further information and prices of this and other insulating specialties, the inventor, Mr. Jacque L. Morgan, city electrician of Kansas City, Mo., should be addressed.

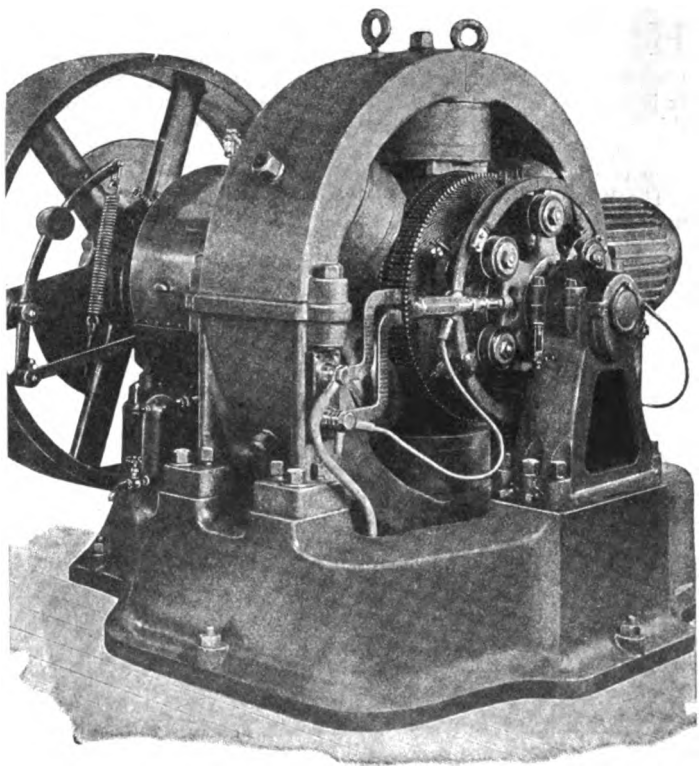
The Moloney Transformer.

The Moloney Transformer has many new and essential features embodied in its construction that merit the careful consideration of central station managers. It has been constructed strictly upon scientific points with a view of combining every modern improvement known in the manufacture of transformers. The manufacturers claim that it covers every desirable feature of economic distribution, combined with all the other salient features necessary to construct a transformer with all that is latest and best.

This transformer has met with unprecedented success wherever it has been used, and the selling agents, the Western Electrical Supply Company, of St. Louis, Mo., have been kept busy in supplying the constantly increasing demands for same. The manufacturers of this transformer have, however, recently increased their plant to such an extent that the Western Electrical Supply Company are now placed in an excellent position to give prompt shipment and handle all orders to the entire satisfaction of their patrons.

Western Electric 100 K. W. Direct-Connected Generator.

THE 100-k. w. direct connected generator illustrated herewith is a good representation of the excellent line of this type of machine manufactured by the Western Electric Company, Chicago and New York. These machines have won considerable favor within recent years, and possess many admirable features. The frames for all sizes, from 5 k. w. to 50 k. w., having four poles, are of the octagonal type with the yoke cast separately from the pole pieces, the pole pieces being made of wrought iron forgings bolted to the yoke and projecting radially inward. All sizes greater than 50 k. w., having six poles or more, have circular yokes with wrought iron pole pieces, as shown in the figure. The armatures are of the iron-clad type, having copper bar conductors imbedded below the surface in insulating tubes and connected at the ends by spiral end connectors, no band wires being used. The insulating tubes are made up of alternate layers of press board, oil paper, and mica, making tubes that are puncture proof. The end connectors are made from sheet copper stampings which are formed into the proper shape and then insulated by a heavy braided covering. All connections between bar conductors and end connectors are perfect both electrically and mechanically.



100 K. W. WESTERN ELECTRIC DIRECT CONNECTED MULTIPOLAR DYNAMO.

The armature discs are built up on a substantial spider which is so arranged as to afford perfect ventilation for the core. Great care is taken in the construction of the armatures so that they are perfectly balanced electrically and mechanically and will operate without vibration. The field coils are machine wound on brass spools, making them interchangeable. They are thoroughly ventilated and are so mounted on pole pieces as to be perfectly insulated from the pole pieces and dynamo frame. The connection boards are mounted on the sides of the dynamo frame, which allows the feeders to be run either overhead or underground with convenience. They are made of slate and provided with connectors having large contact surfaces.

All brushes are of carbon and are so arranged in their respective holders that each one may be removed or adjusted independently while the dynamo is in operation, or all may be moved simultaneously about the commutator. The brush holders are so constructed as to force the brushes in the direction of rotation of the armature, thereby doing away with all possibility of chattering. The brushes are clamped rigidly by their holders so that the current passes through clamped joints only and does not depend on any sliding contacts for a conductor. At the same

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time each brush is perfectly free to move and is given tension on the commutator by a phosphor bronze spring.

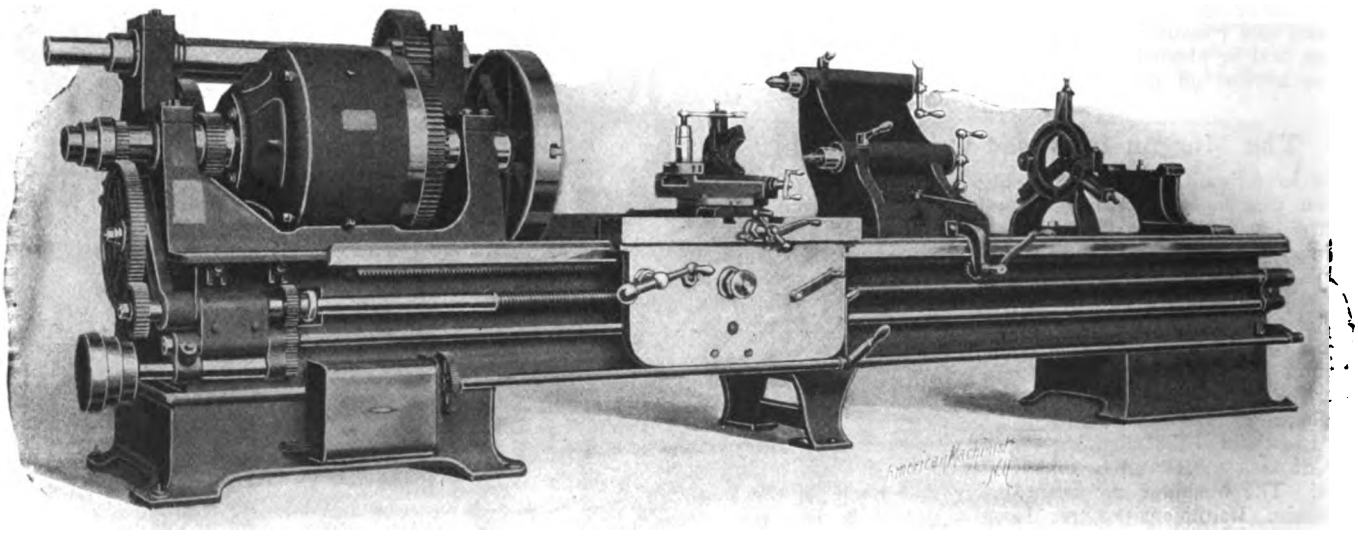
Special attention is given to the field coils and armature where the accumulation of heat would decrease the efficiency of the machine. The heating of armature and fields after ten hours' operation at full load or three hours at 20 per cent. overload, is far below that allowed and usually specified by electrical engineers. The heating of the commutator, although somewhat higher than armature and fields, is very low, which is due to the large commutator used, and the low current density in the brushes. The dynamos are guaranteed to operate for one hour with 50 per cent. overload without sparking or injurious heating.

All material and workmanship is guaranteed to be first-class in every respect, all parts being made from gauges which make them absolutely interchangeable. The generators are built in sizes ranging from 5 to 500 k. w., with 4 to 10 poles, a speed of from 100 to 650 r. p. m., voltages from 12 to 550, and a weight of from 1,200 to 60,000 lbs. More complete data can be obtained on application from the company's main or branch offices.

McCabe Electrically Operated Double-Spindle Lathe.

HEREWITH we illustrate the patent double-spindle lathe with motor directly connected, which has recently been placed on the market by J. J. McCabe, 14 Dey street, New York. It is entirely new, and claimed to be the most complete tool of this kind made. The motor takes the place of the cone on main spindle, and the arrangement is compact and neat, while the running of the lathe is all that could be desired.

The lathe is one of the company's well-known double-spindle machines, that combines two lathes in one—one a 26-inch swing,



DOUBLE-SPINDLE LATHE—WITH MOTOR DIRECTLY CONNECTED.

for the common range of work, and the other a powerful triple gear 44-inch swing, for heavy work. It is a substantial, carefully designed, and well built tool, with wide range of speeds and feeds, adapted for all classes of work, from the smallest up to its capacity.

It is especially adapted for repair shops, where they have a limited number of tools and have occasion to do a wide range of work.

A catalogue, illustrating other similar machine tools manufactured by the company and containing a long list of users will be sent to anyone on application.

Standard Paint P. & B. Specialties.

Purchasing Agent Van de Water, of the Standard Paint Co. says: "With reference to the P. & B. Electrical Compound, it continues to be recognized as a standard article and is specified and called for by general electric, electric light and traction companies not only in this country, but in all parts of the world. The business done by us not only in the electrical compound, but also in the armature and field coil varnish, during 1898, in spite of the fact of the condition due to the Spanish-American war and other causes, was considerably in excess of any previous year since the organization of this company. The sale of this material in Europe is particularly satisfactory and the electrical compounds and armature and field coil varnish are rapidly attaining the high position in the estimation of electricians there, that they have in this country. The branch factory at Hamburg, Germany, has been kept busy ever since it opened, at the beginning of 1898, not only in the manufacture of the materials referred to above, but also in the turning out of the P. & B. preservative and roof paints, P. & B. building, sheathing and insulating papers and P. & B. ruberoid roofing. The orders for the P. & B. insulating tape in both Europe and America have been for some months past far in excess of any previous time since this company began the manufacture of the goods."

Electra Nuernberg Carbons.

Mr. Hugo Reisinger, the importer of the "Electra" Highest Grade Nuernberg Carbons, says that the change now taking place in electric arc lighting is strikingly shown by the enormous and increasing demand for "Electra" carbons. This is largely due to the rapid introduction of enclosed long burning arc lamps, for direct and alternating currents, and series lamps. It has become necessary to run the Nuernberg carbon factory night and day to keep up with the orders that are sent from this country, while at the same time the demand for carbons for the constant potential direct and alternating current open arc lamps, shows no falling off. The above facts tend to show that the enclosed long burning arc lamp is rapidly superseding the incandescent lamp for interior use, while it is also driving the series high tension open arc lamp from the streets.

One need not be a prophet to see that the present rate of change is revolutionizing the carbon trade, and that the low grade carbon, like the poor old horse, will have to find other uses, or give up the fight entirely. Prof. Henry S. Carhart some years ago predicted this, by stating that the days of cheap and inferior carbons would soon be past.

Dicke Ball-Bearing Pay-Out Reel.

Linemen who are accustomed to unwind large coils of wire from the old style pay-out reels will appreciate the advantage of the Dicke ball-bearing pay-out reel. In this reel, that part upon which the wire is placed revolves upon ball bearings and practically removes the friction of the moving parts. On top of a truncated cone, are a number of small balls upon which the reel revolves. Both the balls and bearings are made of the best tempered steel and will stand long and continued use. In practical work, whether the load be heavy or light, there is no increase necessary in the effort to operate the reel; the friction being inappreciable. The reel running easily on its bearings communicates no racking strain to the frame work which supports it, and consequently, in addition to the economy in labor, there is also the

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increased durability of the reel. The wooden parts of the reel are of the best white oak, are strongly mortised, ironed and bolted. The reel is placed on the market by the Western Electric Company, of New York and Chicago, who will furnish prices on application.

The Matchless Electric Lighter.

THERE has long been a demand for a practical electric lighter, which could be used on both electric light and battery circuits.

The "Matchless Electric Lighter," sold by Stanley & Patterson, Frankfort street, New York, made of the finest white china throughout, embodies these two essential points as well as efficiency, durability and economy. The cost of maintenance is

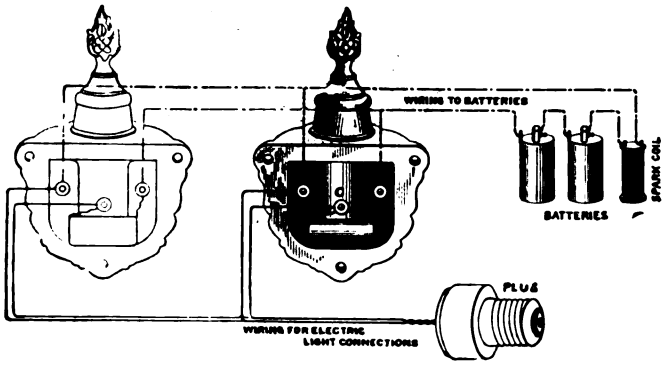

FIG. 1.—DIAGRAM OF LIGHTER CIRCUIT CONNECTIONS.

about one cent per month. On electric light circuits it requires no attention from one year to another, save moistening the asbestos packing in the torch, necessary usually about twice a month with ordinary usage. An attachment plug and cord is furnished with styles A and B, which can be inserted in any lamp

FIG. 2.—PORTABLE LIGHTER.

socket or the device may be attached to the wiring direct as may be most convenient. The lighter is at once available for use.

The lighter in the style wall bracket form shown in Fig. 3 is especially adapted for use in smoking rooms, hotels, cigar stores, and in all places where cleanliness and freedom from danger from discarded matches is desired. Its adaptability to marine work is clearly demonstrated by the satisfaction which an installation of lighters on Mr. Howard Gould's steam yacht

FIG. 3.—STANDARD OR WALL LIGHTER.

Niagara has given. Thirty-eight of the lighters were placed on one circuit on this yacht and have never given a moment's trouble.

The Matchless Electric Lighter is available where there is no electric light current, by merely connecting two cells of dry battery, and an ordinary gas lighting spark coil. The coil never wears out. The battery requires renewal, say perhaps once a year, and often less, according to the use of lighter. A hundred or more lighters may be connected to the same set of batteries, or to the same circuit, and wherever a residence is equipped with electric gas lighting, the lighter can be connected directly to the wiring already installed, and will call for no more attention than would an additional burner on a chandelier.

The endorsement of the board of fire underwriters and the fire department makes its use doubly advantageous wherever insurance is carried.

In ordering it should be stated whether it is for use on electric light circuits, whether to be used in connection with Edison, T. H. or Westinghouse sockets. It can be used on any voltage current, alternating or direct up to 240 volts or on battery circuits.

New Addition to the Crane Co.'s Factory.

Mr. J. B. Barryman, manager of the engineering department of the Crane Co., Chicago, reports that his company has made plans for the erection of a large new additional plant to their present one on the south side of Chicago at the junction of Judd and Canal streets. The new plant will occupy a space of 228 by 94 feet, and be six stories in height. The cost of the new plant is estimated at about $500,000. It will be equipped with the most improved modern machinery, and will also contain a complete electrical equipment for power and lighting. It is stated that the Crane Co. have equipped a great many railway and lighting power plants during 1898 with piping and valves. The prospects for business in 1899 are even better.

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General Electric Large Direct Current Stationary Motors, C. E. Type.

TO meet a demand for larger direct current stationary motors as compact and efficient as motors of the type C. A., which range from ⅛ h. p. to 2 h. p., the General Electric Company has perfected a line of motors known as the type C. E. motors, as well as the latest ideas in motor construction. Designed by experienced engineers and built by skilful workmen, using the best material, they are constructed to withstand the severe usage which motors are apt to receive. Moreover, the design is such that it may readily be modified to meet special requirements. The motor frame which is also the magnet yoke, is of soft steel of high permeability. It is cast in the form of a hollow cylinder with a projecting foot on the outside and seats for the pole pieces on the inside. The short magnetic circuit which this arrangement gives and the use of the best material contributes to make the new motor efficient in all its capacities. To obviate eddy current losses the pole pieces are built up of iron laminations, and are secured to the yoke by through bolts with nuts on the outside. The field coils are held in place by the extended lips of the pole pieces and as the face of the pole pieces covers a large surface of the armature, without increasing the size of the field coils the efficiency of the motor is materially augmented.

The armature is built up of iron laminations assembled directly on the shaft. To prevent eddy currents, each sheet is japanned on both sides, and good ventilation to core and winding is provided by air ducts. The laminations are clamped solidly between two cast-iron spiders, extended at each end as flanges to support the coils. The armature coils of copper wire, form wound, insulated and tested, are placed in the core slots, the ends of the coils lying along the flanges. This arrangement constitutes the "cylindrical" armature winding. As it provides a large ventilating surface for the conductors and reduces the length of wire necessary with consequent decreased resistance, it conduces to cool running and high efficiency as well as to ease of removal and replacement of any coil. The insulation employed is that used with all G. E. railway motors, and is tough,

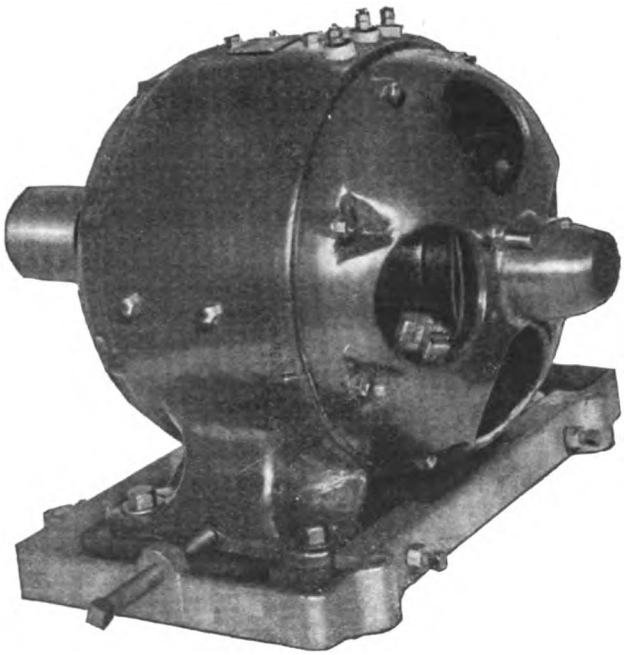

FIG. 1.—G. E. TYPE C. E. MOTOR.

impervious to moisture, and practically indestructible. The coils are securely held in a rigid position and injury to the insulation from sliding or vibration is impossible.

The commutator and brush holders are of the types used with G. E. railway motors. The segments are of hard drawn copper insulated by mica, which between the segments wears evenly with the copper. The armature leads are soldered into slots in the segments and being short are not liable to become displaced and, abrading the insulation, cause a short circuit. The brush holders are of cast brass arranged for radial carbon brushes, which slide in finished ways and are pressed against the commutator by independent pressure fingers giving uniform pressure throughout the life of the brush. There is no sparking, and change from no load to full load requires no shifting of the brushes. The only wear on the commutator is that of friction and the use of carbon brushes renders this negligible.

The bearings are supported by cast-iron end shields. This method of support is lighter, but not less rigid, than pillow blocks, and while affording protection to the working parts, does not lessen the compactness of the motor. Furthermore,

FIG. 2.—G. E. MOTOR.—WALL SUSPENSION.

the motor being symmetrical, a simple quarter or half turn of the end shields allows it to be fastened to a wall or be suspended from the ceiling. The end shields have hand holes which provide ventilation and give easy access to the working parts. In motors intended for use in dusty places these hand holes may be covered by wire screens which offer little resistance to the air, and for continuous service are superior to solid covers. The bearings have ample surface to ensure cool running and are automatically lubricated. The linings are of gun metal in one piece, and rest on the bearings throughout their entire length, being kept from turning by dowel screws extending through the bearing castings. The small number of machined surfaces brought together eliminates trouble in lining up the motor, and renders the spherically seated bearing unnecessary.

In the motors under consideration the four pole construction has been adopted for all sizes down to and including the 3 h. p. slow speed motor. By the adoption of this construction, the use of a steel magnet yoke and the use of end shields to support the bearings, an economy of material is effected which permits, without sacrifice of strength or stability, of the construction of motors much lighter for a given output than machines running at even higher speeds. The magnetic material is economically arranged, the machines are light and compact, the centre of gravity is low and the floor space occupied small.

The C. E. motors are built in capacities of from 2 h. p. to 10 h. p., in slow speeds, and from 3 h. p. to 15 h. p. in moderate speeds. They are conservatively rated, and will run under full load at an unusually low temperature. The standard type will deliver the rated output continuously without rising in temperature above 40° C. above the surrounding air. With the wire screens over the hand holes this will be slightly exceeded. The motors will carry a temporary overload of 40 per cent. without injurious heating. Following its usual practice the General Electric Company makes all parts of these motors to gauge, and duplicate parts can thus be obtained without delay.

Electroplating the Hulls of Vessels.

In an article on the above subject in last week's issue the statement regarding the report of Naval Constructors Bowles and Rock, U. S. N., was not correct, having been based on unconfirmed reports in correspondence from Washington.

India Wants Auto-Mobiles.

The American Electrical Vehicle Company of Chicago has, it is stated, closed a contract to supply pleasure vehicles for several Bombay Princesses. The orders aggregated $26,000, and the vehicles will be shipped during the early summer.

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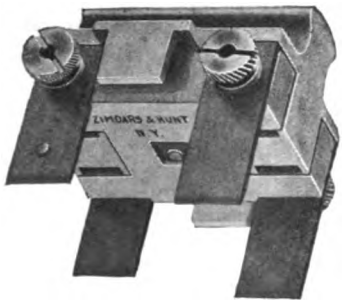
Zimdars & Hunt Removable Fuse Holder.



WE illustrate herewith a little device in the shape of a removable fuse holder, which, on account of its many excellent features, is coming into favor with engineers, architects and contractors. This article, as its name implies, is a fuse holder which can be removed at pleasure from the circuit. In fact, in connection with suitable clips, it constitutes a switch in which the fuse connections are made on the movable part. As will be seen from the illustration, the fuse is attached directly to the switch blades, and thus does away with the necessity of having separate fuse connections provided on the clip blocks. The two blades at one end are provided with pins which fit into appropriate slots in the clips, and when so arranged the fuse holder can be operated in the same manner as an ordinary knife switch. When the fuse melts from any cause, the fuse holder can be lifted out and taken away to be re-fused at any convenient place. Or, as the fuse holders are interchangeable, a previously fused holder can be substituted. Guards are located over the fuse, and prevent the fused metal from reaching the hand, should the fuse blow while the holder is being inserted on a bad circuit. These guards also prevent the fused metal from dropping on other fuses and blowing them, as sometimes happens in panel board work where a precaution of this kind is not taken. While this fuse holder is primarily intended for use on panel boards, it can also be used for any other purpose that a knife switch is ordinarily used for.

Further information and prices will be furnished by the manufacturers, Zimdars & Hunt, 127 Fifth avenue, New York, or their agents.

Fort Wayne Elec. Corp. Affairs.

A special despatch from Fort Wayne, of Feb. 1, says: P. A. Randall, representing unsecured creditors of the Fort Wayne Electric Corporation, will bring suit to-morrow to have the $250,000 mortgage given to the General Electric Company set aside. The creditors claim that the late R. T. McDonald executed this mortgage to the General Electric concern to secure a personal obligation, and that he had no right to make the corporation responsible for his personal obligations. Since the mortgage was executed there have been two reorganizations of the corporation, and the legal tangle is exceedingly complicated. Another despatch says: A new company is forming among Fort Wayne capitalists to purchase the plant of the Fort Wayne electric corporation, against which bankruptcy proceedings are pending. Two hundred and fifty thousand dollars have been subscribed, and more money is in sight.

A Trolley Line for Egypt.

Negotiations have just been closed by the Westinghouse Electric and Manufacturing Company for the equipment of fourteen cars of the ordinary trolley type for use in the City of Cairo, Egypt. It is proposed to build another line to the Pyramids as soon as the natives become accustomed to the operation of the cars, and, later, to connect Alexandria and Cairo by trolley.

AMERICAN ELECTRIC VEHICLE CO., Chicago, have recently received several very large orders for delivery wagons and carriages. Their new factory on Wabash avenue is being equipped throughout with modern machinery and appliances, making it thoroughly up to date in every respect.

THE TECHNICAL AGENCY has recently opened a suite of offices at 1361 Monadnock Block, Chicago, under the personal direction of Mr. J. Ellison Miller; the object of the agency is the supply of technical men, such as engineers, draughtsmen, chemists, etc., to firms requiring such service.

COLVILLE, WASH. Mr. W. D. Allen contemplates putting in an electric light and power plant, and wishes to receive prices and data.

ADVERTISERS' HINTS

THE AMERICAN ELECTRIC VEHICLE COMPANY, 1545 Michigan avenue, Chicago, Ill., claim to have the key to the automobile situation, in their improved battery for that class of work. Its lightness and durability are striking features.

THE STANDARD ELECTRIC TIME COMPANY, Waterbury, Conn., advertise complete electric clock systems for factories, colleges, mines, railways, etc.

THE ELECTRIC APPLIANCE COMPANY, 92-94 West Van Buren street, Chicago, show what their new home looks like in a cut in their "ad" this week.

J. JONES & SON, 62 Cortlandt street, New York, call attention to their desk portables and their full line of electrical supplies.

ECONOMY AND UTILITY may be attained, say the Wheeler Reflector Company, of Boston, by the use of the Wheeler reflectors for all conditions of service with any kind of light.

THE DEARBORN DRUG AND CHEMICAL COMPANY, Chicago, say that boilers may be kept from leaking by the use of their compounds for proper cleaning.

THE EUREKA ELECTRIC COMPANY, 157-159 South Canal street, Chicago, Ill., advertise telephone switchboards.

NEW ENGLAND NOTES

MR. HENRY J. CONANT. This is a familiar name that has long been associated with Westinghouse, Church, Kerr & Co., as that of the manager of their Boston office. It is a principle of this concern to promote their deserving men rather than employ outside talent. In this connection we note with pleasure that the duties of Mr. Conant will be largely increased, and although he will continue to reside at Boston, his work will be of a broader nature than heretofore, dealing with the more general affairs of the concern. Mr. Conant had complete charge of both the management and the engineering of the new Boston Terminal installation, involving a very considerable amount of general engineering. He graduated with the class of 1887 from the Massachusetts Institute of Technology. His experience with Westinghouse, Church, Kerr & Co., which dates back several years, makes him particularly well fitted for his present position of importance.

THE LAUNDRY ROOM at the Beaufort Insane Asylum, city of Quebec, has in connection with the lighting plant an equipment of sixteen 8-pound domestic irons from the American Electrical Heating Corporation. They are said to double the capacity for work. The generating plant is water power.

SWINNERTON & SNIFFEN MFG. CO., of Bridgeport, Conn., has been formed, with an authorized capital stock of $10,500 full paid, to make electrical specialties. The incorporators are T. C. Swinnerton, C. O. Sniffen and M. T. Sniffen.

NEW YORK NOTES.

MR. W. W. CHURCHILL. Chief among the appointments made by Westinghouse, Church, Kerr & Co., as a result of the large increase in their business, is the promotion of Mr. Churchill to the position of Mechanical Engineer. He was graduated from Cornell University with the class of '89, but remained another year at that institution as Sibley Fellow in Mechanical Engineering. He associated himself with Westinghouse, Church, Kerr & Co., about nine years ago, during which time they have handled some of the most important engineering contracts in this country. Mr. Churchill has been closely identified with the engineering work involved in such contracts as the Boston Terminal and the Third avenue power plants, in connection with which he proved himself a most capable man.

THIRD AVENUE ROAD, N. Y., promises to have its underground trolley system running by April 1. The work is delayed only by the winter weather.

WILLIAM E. QUIMBY, 86 Liberty street, New York City,

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manufacturer of the Quimby screw pumps, has received an order for two of his No. 10 pumps, each to have a capacity of from 800 to 1,000 gallons per minute, with direct-connected electric motors of sufficient power to pump against 150 pounds to the square inch. These pumps are purchased by the Chicago City Railway Company, and are to supply water for the largest electric fountain in the world, to be erected in a park in the southern part of the city.

ELECTRICAL INSTRUMENT CO., of New York City, has been formed by C. D. Cooke, T. E. Taylor and G. M. MacWilliam, with a capital stock of $20,000.

RUSSELL TOMLINSON ELEC. CO., of Ansonia, New York City, etc., have received a large order for telephone supplies from Cuba, and another large order from Mexico.

INDIAN HEAD. The proving grounds are to be equipped by the Government with a complete Westinghouse plant for light and power and traction. The order includes generators, engines, Tesla induction motors, etc., of about 300 h. p. capacity and three Westinghouse electric locomotives.

WESTERN NOTES

WILSON, KAN. A new telephone system is being put in at Wilson, Kan., by W. D. Jellison, using the National Automatic Telephone Company's instruments; also one at Great Bend, Kan., Grimes Bros., proprietors, Kinsley, Kan., will have a new telephone system, and have contracted for the National Automatic Telephone Company's telephones and switchboards. G. W. Watson is the leading man in the enterprise.

MR. H. K. GILMAN, president Western Electrical Supply Co., St. Louis, called at the office of The Electrical Engineer this week. Mr. Gilman was on a flying business trip.

MR. SIPE, of Sipe & Sigler, manufacturers of the Willard storage battery, was noticed in Chicago this week.

THE CUTLER-HAMMER CO., Chicago, have under preparation a handsome new catalogue of rheostats which will be ready for distribution in a few weeks.

THE McINTOSH BATTERY AND OPTICAL CO., Chicago, report a large demand for their direct reading voltmeters and ampere meters. It is said that these instruments have met with instant success since they have been placed on the market.

MR. GEO. P. REX, formerly manager Chicago office, now acting secretary of the Columbia Incandescent Lamp Co., has gone to St. Louis to reside permanently. Mr. Rex' removal to St. Louis is regretted by his Chicago friends, as it was supposed that he was a fixture in the Monadnock Block.

THE ELECTRIC APPLIANCE CO. are very proud of their new building at 92 and 94 West Van Buren street. They claim that their new location gives them the largest electrical supply house in the country, with unequalled facilities for doing business and carrying very large quantities of material. The building is about 50 x 90 feet, five floors and basement, with light on three sides, and is certainly an ideal building for any line of business. It should be visited and inspected to be appreciated.

THE MOON MFG. CO., of Chicago, have recently placed on the market a new enclosed arc lamp, which is said to contain several novel and valuable features. They are issuing an attractive pamphlet on the subject.

NORTH ELECTRIC CO., to manufacture telephones, etc., has been formed at Cleveland, O., with an initial capital of $500. The incorporators were: C. H. North, G. C. Steele, D. B. Wick, R. N. Wilbur and M. B. Johnson.

THE UNITED STATES CARBON CO., of Cleveland, O., have got their magnificent new plant into excellent running order and are already crowded with business, though they have been in active operation but a few months. They manufacture electric light carbons for both open and enclosed arc lamps, and use machinery totally different from that used in any other carbon factory. As the factory was only built during the past year, it has been equipped with the most modern machinery capable of producing the most exact work and of the best quality, and they have also installed some of the largest machinery ever used for carbon manufacture, capable of making the largest carbons ever produced for electro-metallurgical and electrolytic purposes. Mr. C. L. Saunders, who is the general manager of the company, was for five years superintendent and mechanical engineer for the National Carbon Co., of Cleveland, and has therefore had excellent experience in carbon manufacture, and under his vigorous management the company have secured such an influx of business that they are already doubling upon their machinery and capacity. The company are entirely unallied with any other carbon factory and are meeting with great success on account of the excellence of their products and prompt attention to business.

A CHICAGO DINNER.—A delightful electrical dinner was given by James M. Knox, and Eugene H. M. Loughrey, electrical engineers, to their electrical friends. The dinner was served in a novel manner, and in novel receptacles. Salt cellars were Edison wall sockets, pepper in telephone receivers, butter dishes were ceiling rosettes, and punch was served in an arc light globe. Among the guests were Chas. Burlingham, of McDermid Manufacturing Company; Mr. C. D. Wilkinson, of the Western Electric Company; Frank E. Colbert, N. C. Harrison, of Williamsport, Pa., and W. J. MacConnell, of The Electrical Engineer. The evening was pleasantly passed by toasts and story telling and it was in the small hours of the morning when the guests said good-by to their ingenious hosts.

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Department News Items will be found in advertising pages.

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The Electrical Engineer.

Vol. XXVII. FEBRUARY 16, 1899. No. 563.

POWER TRANSMISSION

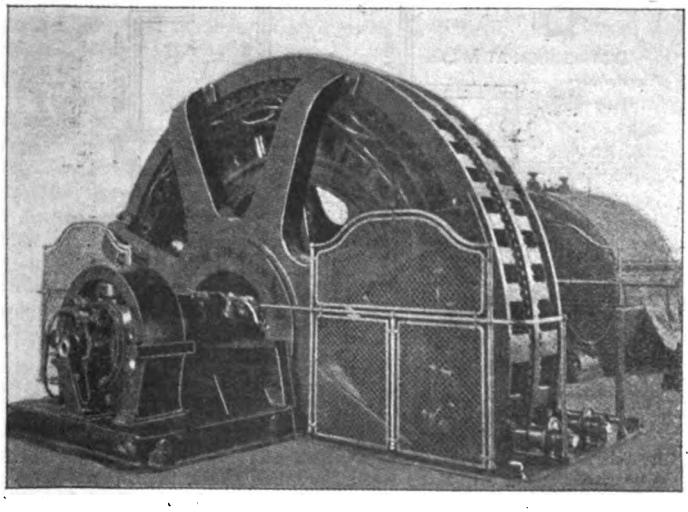
European Transmission Practice and the Water Power and Electric Plant at the Adda Rapids Near Paderno, Italy.—II.

(Concluded.)

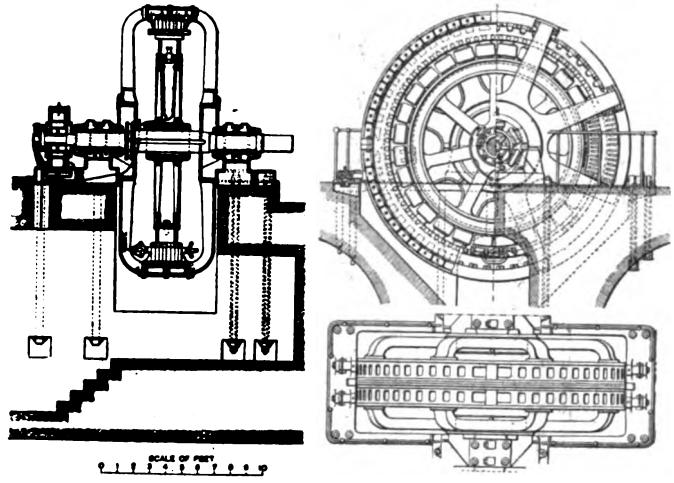
ONE of the most remarkable parts of the plant is the switchboards. The importance given to switchboards is of quite recent date, and arises from the latest experience in materials. In the first stations where large currents at high pressure were used, no greater importance was given to the switchboards than to those for ordinary lighting stations. But the numerous difficulties that arose gradually proved that in such installations the switchboards represent one of the most delicate parts of the whole plant. Consequently they ought to be designed very carefully, without sparing expense, and provided with plenty of room. The switchboard at Paderno, built on these lines, has an area of about 17 square feet, and is fixed in a large opening in the middle of the wall of the dynamo room. The dynamo instruments are placed on a gallery 9 feet 6 inches above the floor, while those for the line are placed on the other side of the switchboard room. The dynamo switchboard is divided into nine panels, of which seven belong to the seven alternators, while the other two are used for the bus-bars and are fixed in the centre of the board.

Each of the panels of the dynamo board carries the following apparatus and instruments: One double-pole high tension switch, three fuses, one change-over switch, one regulator for the exciting current, one regulator for the exciter field, one switchboard transformer, one voltmeter, one ammeter, one wattmeter for the alternating current, one ammeter for the exciting current, one voltmeter and synchronizing lamp.

These are more or less the apparatus and instruments which are found on all the panels; some, however, merit special notice. With regard to the switch, it may be remarked that all currents at a low voltage can be broken without difficulty because the pressure is not sufficient to maintain an arc when the two contacts of the switch are at a little distance from each other. Small currents at very high voltages can also be broken without special apparatus, because up to a certain limit they lack the necessary energy to overcome the resistance of the air. But when both pressure and current are large the case is different. With 3,500 volts and 150 amperes one gets an arc which may exceed 3 feet in length, and with 8,000 volts and 80 amperes an arc which exceeds 5 feet. When those enormous arcs are developed between two parts of a switchboard, they are carried upwards by the action of the hot air, and pass through any conductors they may encounter, melting metals, smashing insulators and burning wood and rubber.



BROWN, BOVERI & CO. GENERATOR AT PADERNO, ITALY.



PADERNO GENERATOR.

The length an arc may assume depends, first of all, on the nature of the dielectric in which it occurs. It depends, in the second place, on the material of which the electrodes are composed; thus, if the electrodes are of copper we get a much longer arc than if they are of carbon, because the copper vapor, which volatilizes and burns, forms a path of higher conductivity than that formed from particles of carbon. And here we find an explanation of the efficacy of quick break switches. With a quick break switch of the type of the General Electric Co. a current of 70 amperes at 3,600 volts is easily broken, but if it is done slowly with the same switch the arc cannot be extinguished, because, with the increase in rapidity of movement, the formation of copper vapor is rendered much less. The principle of a quick break in oil is employed in the construction of the high-pressure switches at Paderno.

Safety fuses present an analogous problem, but, fortunately, the solution is very safe and simple. The fuses made by the firm of Brown-Boveri & Co. have given such a perfect action at 5,000 volts as to justify considerable confidence in their action at higher pressures. The fuse wire is stretched out in an open tube of composition or of porcelain. When the fuse goes the arc thus formed instantaneously expands the air contained in the tube, and causes a kind of explosion which causes the arc. On the left of the board there is a change-over switch, which embodies some novel features. The whole of the installation, commencing with the switchboards of Paderno going step by step to Porta Volta and Santa Radegonda, has been designed so that there may always be the possibility of splitting up the supply into two distinct parts. The bus-bars are in duplicate, and each dynamo may be connected up to either of the two.

Thus the lines, as well as the transformers at Milan, the dynamos at Porta Volta, etc., can be separated from each other. This has been designed so as to keep the two supplies distinct, should only supply have special requirements, or be a source of dis-either supply have special requirements, or be a source of disturbance to the other.

The wattmeter on the switchboard of each dynamo was introduced more with the idea of giving a true relative indication of the load of each alternator than to give an absolute reading, because when several alternators are running in parallel, the ammeters give very little indication of the true load on the machines, this being affected by the difference of phase. The electrostatic voltmeters placed on the main switchboard measure the pressure at Milan. Three pilot wires are fixed on the posts under the principal conductors, and connect the voltmeters directly with the secondary circuit at 150 volts placed in the station of Porta Volta. These are of very great importance because it is accord-

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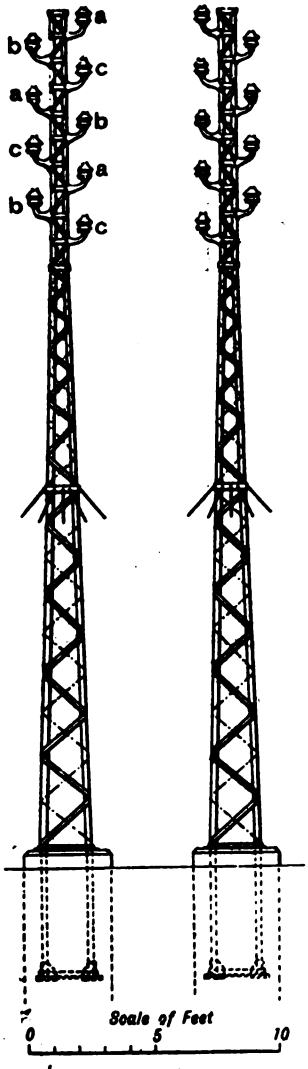
ing to their readings that the pressure at the station is regulated.

Behind the row of dynamo switchboards are fixed the line switchboards. The lines are six in number, and each one has its own switchboard with change-over switch, fuses and ammeters.



Line Poles.

Insulator.
One-sixth full size.

POLES AND TYPE OF INSULATOR USED ON PADERNO TRANSMISSION LINE.

All the switchboards are in general accessible where possible; each section may be completely separated from the others which are live, so that a man can work on them or clean them with perfect safety. They are all made of iron, porcelain and marble, and no combustible material is employed. The connections are all made of rigid bars and the tout ensemble is symmetrical, simple and mechanical.

The lines run from the switchboards into a room above where the lightning arresters are placed; from thence they pass through suitable openings placed in the back wall of the room to the first post. As we have already said, the number of wires in the line will be 18. A high tension line of this description intended for an important public supply, like that of Milan, had to be designed with special care and precautions to avoid breakdowns; it was not only necessary to have the line well made, but to have a line which could be repaired without interrupting the supply. From the station of Paderno and that of Porta Volta runs a double row of posts; each row carries nine wires, and is at a distance of 6 feet 6 inches from the other. When it is necessary, from any reason whatsoever, to work on one of the lines, the whole of the section to which it belongs can be cut out of circuit, and the supply carried by the other half alone. At times of heavy load in such cases there will be a greater drop of pressure, but this has been provided for by the possibility of increasing the pressure of the alternators to 15,000 volts.

In the early alternate current installations, the line was one of the chief sources of failure, and that because not even a remote idea was entertained of the importance of the effects of mutual and self-induction. It is curious that although academically the case had been worked out some time before, yet among the lines proposed by the different manufacturing firms there were solutions perfectly diverse and contradictory. Now all this part is well enough known, so that it is possible to proceed with perfect safety. It is recognized that, in order to have a weak, small inductance, the wires must be of small diameter and far apart, necessitating, in the case of heavy currents, a considerable number of wires. Then there is another very important point, and that is, when the wires are numerous they must be arranged in such a manner that the effects of induction are equal on all. If not, there will be a tendency to produce idle currents between the wires belonging to the same branch of the system.

The theoretically perfect arrangement of a number of conductors carrying three-phase currents would be that in which each conductor was placed in the same condition of induction with respect to the others. A cross-section of the arrangement would show all the wires placed at equal distances on a circle. This form of grouping the conductors, although possible to realize, is not very practical, especially if the number of wires is great. The form which, after the circle, gives the smallest mutual induction between the different wires of the same branch is that well known method in which the wires are arranged in the form of a triangle. This is the arrangement actually adopted on the Pader-

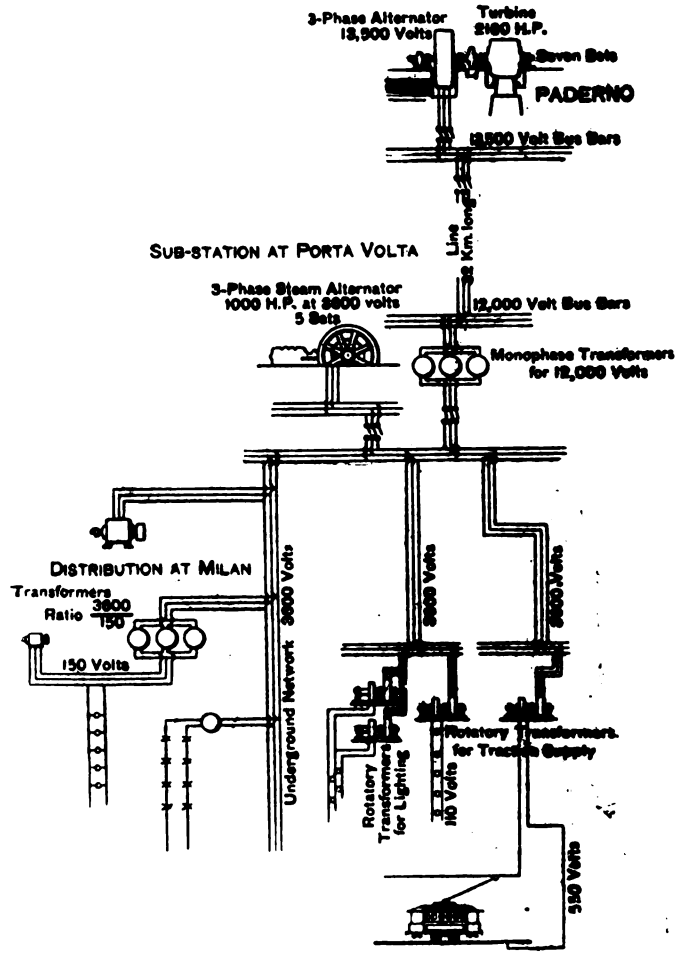


DIAGRAM OF DISTRIBUTION SYSTEM AT PADERNO, ITALY. LENGTH OF LINE, 32 KM.; No. OF WIRES, 18; DIAMETER OF WIRES, 9 MM.; METALLIC POSTS 60 METRES APART.

no line. The wires are 0.354 inch diameter, and the distance between the nearest is 2 feet. They are of electrolytic copper of 98 per cent. conductivity, and are fixed up in such a way as to have, with a span of 197 feet, a dip which varies from 2 feet in the hardest winter to 4 feet in the hottest summer.

In lines for alternating current it is necessary to consider the loss of energy as well as the drop of pressure. The loss of energy is the product of the resistance by the square of the cur-

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rent, and will be about 9 per cent. at full load when the power factor is 80 per cent. The expression for the drop of pressure is somewhat more complex. The special case was studied by the late Prof. Ferraris, and the resulting calculation is of the highest interest. In this calculation the branch of the three-phase system to which each wire belongs must be taken into account, because the effect of mutual induction is a function of the positions of all the nine wires, the relative distances and the currents which flow through them. The drop of pressure is a function of this coefficient of mutual induction, the ohmic resistance of the wire, the current, and lastly the difference of phase caused by an inductive load. All these quantities properly combined give as a result the drop of pressure which in our case is about 12.5 per cent., while the loss of energy is only 9 per cent.

This is one of the first lines in which entirely metallic masts are used. Although the fall of one wire or the breaking of an insulator may cause a dead earth, their mechanical superiority is undoubtedly of great value. Besides it is not at all easy to find wooden posts of sufficient length, and the construction of mixed posts is not a satisfactory solution; hence, it was preferable to take greater care in the design of the insulators, and to employ posts entirely of iron. The post is made of light lattice work. Each post weighs about 9 cwt., and is embedded in a mass of concrete. Where there are curves along the route two posts are joined together to form a St. Andrew's cross. The insulator carrier is very strong, and has a light steel spindle in order to prevent the accumulation of snow. Under the conditions to which our line is subject, the insulator is a detail of the highest importance, and is of special design. There are two types which seem to meet the requirements of the case—the one the American bell type, which has an internal core of glass or hard porcelain; the other the multiple umbrella type, made entirely of porcelain.

The idea of the American type is, by means of the glass or hard porcelain part, to offer a high resistance to perforation by electrical discharges, while the external portion of enamelled porcelain presents a long path for surface leakage and for direct discharges through the air. In the multiple umbrella type the first object is accomplished by increasing the thickness of the porcelain in proximity to the head, the second by the large development of the leakage surface. The available experience in materials not being very extensive, it was decided to use one of the types on one line and the other on the other. Both are constructed by the Societa Ceramica Richard-Ginori. The line does not follow the same route as the roads, but crosses the country in a direction very nearly that of a straight line, and the angles which it makes, either to avoid houses or other obstacles, do not in any case exceed 3 deg. or 4 deg. Larger angles are used for crossing the railway lines and water courses, and also where it enters Milan. If it had followed the roads the work of inspection would have been easier, but it would have increased the angles and lengthened the route.

The Edison Company pays the proprietor a price per yard of route which covers the wayleave for wires and posts, the repairs of damages during erection in a strip of land 10 feet wide, and the damages incurred in inspecting and repairing the line during a period of 30 years. The Edison Company, in return, possesses the right to pass along this strip of land with vehicles and carts as often as may be necessary. The work of inspection is thus quite an easy matter.

The lightning arresters now being tried on the transmission lines are the Wurts-Westinghouse and the Siemens.

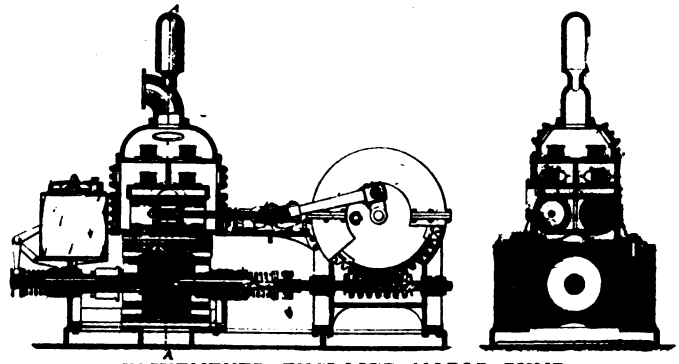
The line reaches Milan at the station of Porta Volta, where it is received on a suitable switchboard. From the switchboard the currents are conveyed to the transformer chamber. The transformers are supplied by the firm of Ganz & Co., are of the three-phase type and have a ratio of 12,000 to 3,600 volts. Their construction is quite simple. They consist of three columns of laminated iron disposed in one plane. On each column are wound a number of coils belonging alternately to the primary and the secondary circuit. This type is criticized by some from the point of view that not having the three magnetic circuits equally long it may give rise to a dissymmetry of the system. But the objection appears unfounded, and it is always possible in this case, where the transformers are numerous, to connect them in such a way as to compensate for the dissymmetry. The output of each transformer is 350 kilowatts, and its dimensions are: Height, 6.9 feet; length, 6.56 feet; width, 3.28 feet, and weight, 7.75 tons. The secondaries of these transformers are carried to a switchboard which forms part of the general switchboard of the station at Porta Volta.

The works were commenced in February, 1896. Water was admitted to the canal in August, 1898, and the current was put on the line on September 28th. Public supply was given in Milan from Paderno on October 15th for the three-phase distribution and Edison network, and on October 29th for the traction service. The experience of a month or two is not enough to judge of the ultimate success of such a scheme, but it is highly satisfactory to know that the high-tension worked perfectly, the dynamos gave their guaranteed efficiency, and the line losses were exactly as calculated.

Eickemeyer Direct-Connected Electric Pump.

THE advantages possessed by machinery driven by direct-connected electric motors are now so well established and understood that any innovation in this promising field may be looked upon as a dangerously competitive device. Pumps driven by electric motors have already won an established reputation, and their popularity will increase with a decrease of current consumption and a simplification of construction. Both of these and many other advantages are claimed for the electric pump recently patented by Mr. Carl Eickemeyer, and shown in longitudinal and vertical cross sections herewith.

The support of this pump is an electric motor which is directly connected to it by means of a worm or gear in such manner as to obviate the necessity of introducing relief-valves and by which is produced as highly an efficient pumping machine (with a flexible coupling between the pump and the motor) as that



EICKEMEYER ENCLOSED MOTOR PUMP.

found in the belt connected pumps, whereby all jars from water hammer, slamming of the pump valves, etc., are not directly transmitted to the motor through the connecting driving mechanism. This feature of the machine not only insures steady operation, but greatly increases the life of the machine and at the same time allows the motor to be started without load, thereby taking the smallest possible amount of starting current. The load is gradually applied to the motor as the speed increases, the maximum load being received at the time that the maximum speed is attained. To reach the desired result, the inventor has devised relief springs, which are carried by a worm shaft and permit the axial motion of the worm, which is, as it were, a combination of the motion of the worm and that of a rack. This axial rack motion is independent of the rotation of the armature of the motor, which armature is mounted on a sleeve in which the worm shaft is feathered. This independent rack motion is proportionate to the load applied to the motor and is used as a dynamometric regulation for the motor in either automatically varying a set of resistances in the armature circuit or automatically changing the direction and intensity, or both, of the series field. Should the motor be stopped with one of its relief springs contracted under load, the current in the armature is automatically changed through the medium of a reversing starting switch before the pump can again be started. By starting the motor in the opposite direction all the expanding motion of the compressed spring and the contracting motion of the opposite spring give sufficient range to start the motor without load and to reach its highest speed by the time the maximum load is applied. At the time the maximum load is reached the normal running speed is also reached, the armature resistance has been gradually cut out, and the counter electromotive force has risen to its maximum degree and has cut down the armature current to a safe limit. Should the load for any unforeseen

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reason be suddenly thrown on the motor at any time, a set of safety resistances are thrown into the armature circuit in order that the current in the armature may not be suddenly increased by a consequently sudden decrease of speed. On the other hand, should at any time the load be suddenly taken off the motor the speed will remain practically constant, as the armature resistance is automatically thrown in the circuit before the armature can respond to any sudden decrease in the load.

The series regulation is used in a modified system of regulation in which the coils at starting exert a magnetizing effect on the armature and are gradually cut out as the motor rises to speed, while at the time the normal running speed is reached the series coils are cut out.

Another novel feature of the construction—namely, that of the motor—is in the winding of the field coils, which, in the shunt field are wound so that the outer portions of the coils are approximately one-half the thickness or horizontal width of the inside portions of the coils. This allows the flattening of the coils on the inside to get the motor as thin as is desirable and at the same time makes the outside wires of the outer side of the coils effective, which would otherwise be ineffective, in producing magnetic lines of force in the field core. The series regulating coils are made rectangular without bend and directly magnetize or demagnetize the armature, as the case may be.

The great advantage of this electric pump is that a motor is obtained which can be started without load, thereby taking the smallest possible starting current. The use of relief springs will prevent any sudden jar—such as that caused, for instance, by water hammer or slamming of the valves common in pump machinery generally—from being thrown suddenly on the motor or on the pump driving mechanism, which would otherwise squeeze out the lubricant of the gearing and greatly increase the wear of the working parts. The automatic dynamometric system of regulation prevents the motor from being affected by any sudden increase of current which would otherwise flow through the armature from any sudden increase of load. The automatic regulation also protects the motor against any racing that might occur by suddenly throwing the load off the motor. This system of regulation might also very readily be made, so as to automatically stop the motor under certain pressure, and thereby adapt the machine to hydraulic pressure service or hydraulic elevator service, and thereby do away with an inefficient boiler and steam pump in many cases where an electric current is attainable and a hydraulic elevator is desirable over the electric.

The complete machine takes up about the same area as a hydraulic duplex pump of similar capacity and does the same work with only about fifty per cent. of the power of the former. It is evident that the construction can also be used with air or gas compressors or other fluid pumps with equal advantage.

ELECTRIC LIGHTING.

The Trend of Central Station Design.[1]

BY B. J. ARNOLD.

THE problem which confronts the power station designer is almost invariably that of the operation of arc lamps, incandescent lamps, and motors for various purposes, with the greatest degree of economy, and with as little expenditure in first cost of plant as possible. This is strictly true of combined lighting and power stations which present the most difficult cases to handle. When, however, the problem is simply one of the development of electrical energy for power purposes only, such as railway work or transmission work, it becomes much simplified. Since the question of the design of a station is interlinked with and dependent upon the system of distribution adopted, we find ourselves struggling with many of the old questions and some new ones; such as the alternating arc versus the series arc, and the constant potential arc; the polyphase transmission plant versus the direct current; the advisable voltage, either alternating or direct, to adopt for central station work.

While I do not, in this paper, presume to settle these questions, we must necessarily form some idea of their probable solution for general cases, for otherwise we can hardly expect to speculate on "The Trend of Central Station Design." The old belted station, we may consider obsolete, and come at once to the general types which have been recently installed by competent engineers, and which may be considered as embodying the latest ideas of those skilled in this class of work. In all of these stations we find certain main parts which may be considered as accepted practice, as follows:

Of course there are many belted stations running and doing excellent service, which simply speaks well for the engineers and designers, and more especially the manufacturing companies who installed them in the earlier days, because at that time there were few engineers skilled in this branch of work, except those in the employ of the manufacturers.

The points in accepted practice are, then: Water tube boilers, capable of carrying high steam pressures. This probably will be disputed somewhat by the advocates of other types of boilers, and with some reason, but it nevertheless has become almost standard to use water tube boilers in modern central stations.

Mechanical stokers, or improved furnaces or grates.

Self-supporting brick or steel stacks—usually steel. A steel stack can be put up for considerably less money than a brick stack, and for all practical purposes it is equally as good, and can be maintained a sufficient number of years to warrant its adoption in almost every case, if properly looked after.

High pressure steam piping is not duplicated, as was thought necessary by engineers eight or ten years ago, practice having proven that one single steam header can be divided so as to make a plant reliable if the engines are properly located with reference to the boilers and the header. I planned one plant in 1891 with a duplicate system of steam piping, and I firmly believed in it at that time, but have never since had occasion to use the duplicate system, and have never since installed one. I think there are few engineers in the country to-day putting in plants with duplicate systems of piping, unless in buildings where it seems necessary to do it, and on account of the peculiar location of the engines with reference to the boilers. Steam piping costs excessively in a power station, and the less of it put in the better, because there is then less radiating surface to waste heat and fewer parts to keep up. The diameters of the steam heaters which are being placed nowadays are somewhat decreased, as compared with those installed four or five years ago.

Large compound condensing steam units. It has become accepted practice to install as large engines as practical, on account of the decreased cost per horse power and the increased economy of a large engine over a small one. They are almost invariably compound engines, where it is possible to condense, and in many cases whether it is possible to condense or not. The tendency toward triple expansion work is not as strong as it was five years ago, it having been determined that for almost all cases a compound engine will get nearly as good economy as a triple expansion engine, and in many cases just as good; requires less investment, is less costly to maintain, and the difference in economy of the triple expansion over the compound is so slight that it makes it inadvisable to install, except in exceptionally large sizes. On account of the excessive diameters of the low pressure steam cylinders in large compound engines it is the practice to install triple cylinder compound engines, that is to divide the low pressure cylinder into two smaller cylinders, the combined area of the two being equal to the area of the large cylinder of a single compound engine.

Direct connected generators of large capacity. What has been said in general regarding large steam units applies equally as well to electrical generators, because the larger the unit the greater the economy of the combined unit.

To these chief features of design, which have become so generally accepted as to require little or no discussion, there may be added several features which may be justly called "tendencies" or "trends," which have not yet been universally adopted.

Under the first heading come economizers. Economizers as you are aware, consist of a series of vertical cast-iron tubes carrying water within them and around the outside of which the gases pass from the boilers to the smokestack. There is no doubt, in my judgment, but what there is economy in the use of an economizer, ranging from five to seven or eight, and sometimes as high as ten per cent. In order to get the benefit of an economizer, ample draught must be provided. Sometimes an economizer is installed where the draught is poor, the result being no economy and the annihilation of the draught. There

[1] Read before the N. W. Elec. Assoc. Abstract.

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is only one solution for this, and that is to increase the height of the stack or introduce mechanical draught to realize the benefits of the economizer.

Mechanical Draught. Under this head there are two types induced draught and forced draught. Induced draught is a device which consists of a large fan or fans driven by steam engines or electrical motors, which are placed between the economizers and the smokestack, or if economizers are not used, between the boiler flues and the smokestack, the object being to draw or suck the smoke from the boilers through the fan and deliver it into the stack. The advantages of the forced draught scheme are: First, a lower and less expensive stack can be used. In fact, no stack at all is required, except to get the gases above the buildings in the immediate neighborhood of the property. Second, the fires can be handled under any and all conditions. We are all aware that the condition of the atmosphere changes our draught, and in case a stack is no larger than is required, there are days when it is difficult to hold steam, and it becomes necessary to put more boilers into service than would be necessary if a mechanical draught fan were used. Where the economizers can be installed in connection with induced draught an economy is always effected.

Then there is the forced draught which consists in blowing air under the grates of the boiler and forcing it up through the fire and into the stack, which is supposed to perform the same function that the induced draught does. The objections to it are that inasmuch as it creates pressure in the fire-box, the gases are liable to escape out into the room and make a distasteful fire room. Otherwise the results accomplished are practically the same as with forced draught, and it is considerably less expensive to install, and this is its chief advantage.

Cooling Devices. Under this head come cooling towers and cooling tables. In most plants in this country there are probably no facilities or natural opportunities for getting water for condensing purposes, and until recently we have thought it was advisable to continue to operate these plants non-condensing. During the past two years there has been a tendency to put in these cooling towers, and when properly put in there is always an economy effected, resulting in a net saving of at least 15 per cent. in fuel. A tower consists of a series of vertical tubes or sheets, usually within a wrought-iron frame, through which air is forced by blowers, driven by steam engines or electric motors, and down through which flows, or sprinkles, or is spread, the water delivered from the condensers. The water coming in contact with the air is cooled, and accumulates at the bottom of the tower, and is then pumped into contact with the steam and condenses it. The same water is used over and over, so that only 5 to 10 per cent. will have to be renewed on account of the evaporation. The 5 per cent. must be added from the city water works, or other outside source.

In place of the cooling tower, where real estate is cheap and available, a table can be erected, consisting of a series of boards laid gridiron shape, upon which the water is delivered by the condenser pumps and is sprinkled down through the boards, and the air from the atmosphere penetrating through underneath the shelves comes in contact with the hot water and cools it. It then forms a pool at the base of the shelves and is taken from there and pumped back in contact with the steam in the same manner as in the cooling tower. This device can be installed for the same, or less amount than a cooling tower, and it is advisable to install it where there is sufficient real estate to place it upon because it requires no power to cool the water, and power is required to drive the fan of a cooling tower.

Motor Driven Auxiliaries. Many of the most modern plants are equipped with electrically driven air pumps, boiler feed pumps, and cooling tower motors, if a tower is used. There is a question as to whether this is the most economical thing to do or not. Some believe it to be so. Others maintain that the latent heat derived from the exhaust from the steam cylinders of the steam driven auxiliaries, if run through a surface or closed heater, more than compensates for the wasteful use of the steam by these steam pumps. I incline toward the belief that there is economy in the use of electrically driven auxiliaries, on account of the non-wasting of heat by pipe radiation, if for no other reason, because the primary objects to be obtained in a power station are to generate the steam with as little fuel as possible, lead it as direct as possible to the steam cylinders, where it is to do its work, and exhaust it in to the vacuum as quickly, with as little pipe to radiate heat, as possible, and electrically driven auxiliaries seem to me to accomplish this result better than any other.

The rotary converter is a machine for converting from one form of current to another, or from one pressure to another pressure of the same form of current. A machine for converting alternating to direct current or vice versa, consists of a single armature revolving in one field, carrying two commutators, one direct on one side, and three-phase, two-phase or single-phase rings on the other, being capable of taking alternating current into the phase or ring side and delivering direct current on the other, or commutator side.

These devices are coming rapidly into use for transmission work. A number of the most modern railroads in Europe and in this country have been equipped in this way during the past year, and with excellent results. There is one road where this device has been put in under my own supervision, which has been operating very satisfactorily since the first of last July, transmitting three-phase at 5,500 volts, and then converting it to direct current and delivery out on the line of 600 volts. In most cases 95 to 97 per cent. efficiency may be depended upon, if the machine is reasonably large, and operated at full load.

Under this head may be classified the synchronous motor driving series arc machines. One type of modern central station is utilizing its old series arc machines for supplying other circuits by driving them with synchronous motors, in case it is an alternating plant. This makes a very good combination and eliminates belts entirely from the station. The efficiency of such combined synchronous motor with arc machine is seldom more than 72 to 75 per cent.

One device, known as a rectifier, has been used quite extensively in Europe, but not in this country. It consists simply of a commutator revolved by an independent source of power, a small steam engine or motor, belted or directly connected. This commutator will take in alternating current on one side and deliver one, two or three-phase current on the other, accomplishing the same result as a rotary converter, without the use of the field coils, or any revolving portion except commutators; and it seems to me that we are somewhat behind in not looking into it more thoroughly in this country, for it certainly can be manufactured for less money than the rotary converter. This is mentioned merely as a tendency in transmission work. The efficiency of it is about 97 per cent.

We now come to what is at present known as the combination generator, which wants a name, and the man who can successfully name it and have his suggestion generally adopted, will, in a sense, become electrically immortal. It consists of a machine having two commutators and capable of generating current at two voltages. It may be direct current on each end or alternating current on one end and direct on the other, but, in either case, it is a machine deriving its power from an external source in contradistinction to a rotary converter, which revolves itself, by means of the current passing through it. These machines are coming into use for railway work, telegraphy, and printing office work. They seem to be the connecting link between the alternating and direct current apparatus. A power station installed with such machines is capable of generating polyphase currents and transmitting such current by means of static transformer, to a long distance at a high potential, then running through rotary converters, and delivering out on the line direct current, thus enabling us to utilize our direct current motors which are already installed. The efficiency of such a machine is from 92 to 98 per cent., dependent upon its size.

Now we come to the head of boosters. Under this there are two—rotary and static. The rotary booster is a machine consisting of two dynamo electric machines, one of which is a motor which may be either alternating or direct current, directly coupled or belted to a generator, either alternating or direct current, or arc. This machine is used mainly at the present time for use on long distance feeders in railway and central station work. The generator end of the machine is series wound, and through it passes all the current which goes through the feeder to which it is attached. It is a low voltage machine and increases the voltage on the feeder to which it is attached, a sufficient amount to enable current to be delivered at the end of a long feeder at the same pressure that is delivered at the ends of shorter feeders connected with the system. In other words, it is a device to save copper. But when it is used, the line loss is increased. However, under conditions where for short periods of the day the load is heavy, it pays to do this instead of adding the re-

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quisite amount of copper. It is adopted in a number of the Edison central stations of the country at the present time, and in some railroad plants. It is also largely used in stations operating storage batteries, for increasing the potential when charging. The efficiency of such a machine is from 80 to 85 per cent.

A static booster is practically a transformer, and is intended to be upon the long feeders of alternating systems. It performs the same function that the rotary booster does, by raising the pressure of the long feeder to a higher potential, so as to make the current delivered of the proper potential. It has an efficiency of 90 to 97 per cent.

Storage Battery. The advantages of the storage battery auxiliary have been so thoroughly discussed of late, that it will be unnecessary for me to enter further into a discussion of its merits. While some engineers are not yet ready to consider its use established practice, its adoption by many of the leading direct current stations of this country should prove its usefulness. I say this impartially, because I have no connection with any battery interests at the present time, although I have had until recently.

Multi-Circuit Arc Dynamo. There is one type of machine whose future has not yet been determined, and perhaps no man can at present safely foretell its future, but there seems to be a demand for it. I refer to the multi-circuit arc dynamo. There is such a machine made to deliver current for four circuits of about 100 lights each, and if the series arc is to survive, this type made to deliver current for 5 to 10-100 light circuits will be the arc machine of the future, and it will revolve at the same rate of speed as our present direct connected incandescent or alternating machines do, because we must eliminate belts. I am speaking of large stations, and, as I say, if the series arc is to survive it will be driven by large machines with slow rotative speeds. Such a machine will probably not have an efficiency greater than from 80 to 82 per cent., and that is what militates against it, the same as the low efficiency of the present series arc machine does.

Having thus enumerated somewhat briefly the principal factors which are working to shape the design of the future central station, I will briefly describe two types of stations which have lately been built, and seem to represent the latest practice.

1. The composite station, consisting of two or more independent steam units carrying upon the engine shaft a direct connected generator suitable for giving light or power, and in addition, a pulley or fly-wheel carrying a belt or rope driving on to a common shaft to which the other engines similarly drive, and from which small direct current arc machines or other old style machines derive their power. This type is admirably adapted for utilizing out-of-date machinery. There have been several large plants of this style installed in the last two or three years by a leading firm of engineers, and the stations, I understand, are giving excellent satisfaction. I refer particularly to the stations at Toledo and Washington, and the solutions of the particular conditions of those cases seem happy ones, because they enable the owners of the properties to utilize all of their old machinery, until such times as it may be deemed advisable to change.

2. Consists of independent engines carrying direct connected generators. This type is admirably adapted for plants where but one kind of current is delivered, but in case two kinds are required, it becomes necessary to have a generator of each type upon each engine shaft, or have double the number of reserve units that would be required if but one kind of current were desired from the plant. In either case, the investment in plant becomes excessive to insure reliability. Two or more kinds of current can be obtained from such a plant by making all of the generating units alike, so far as kinds of current is concerned, and driving secondary generators by means of motors running from the twin generators. This means is often adopted in rebuilding old plants for driving the old series arc machines, being directly coupled to an alternating or direct current motor driven from the main bus-bars. While the stations I mentioned a few moments ago are good engineering, I believe this is better engineering, that is, to eliminate belts entirely, and if we have a number of different types of machines to drive, we better produce our energy from standard machines of the same character and size, if possible; then drive the older type of high speed machine directly connected from motors, and the efficiency of the combined plant will, I believe, be better than where the belted type is used.

3. There is one other method of construction which I will not class as accepted, but mention it as a tendency in power station design, known as the "Arnold System." There have been several of the plants installed, in which the generators are carried on independent bearings, and all made available from more than one engine, but as I do not wish to take advantage of you, I will refrain from discussing the merits or demerits of this system. It is claimed by its advocates to have certain advantages.[1]

In conclusion we all know that our ideal central station will be designed when we have secured an electric generator capable of producing energy for universal use, and the necessary auxiliaries in the way of motors and lights to satisfactorily use this energy for all purposes when distance is taken into account. Our expectations and our hopes point toward the alternating machine, but before we can accept it as our ameliorator, we must ask its advocates to produce a motor which will start and operate successfully on variable loads without seriously affecting the balance of the plant, and of producing a given amount of light with the same energy and cleanliness that it is now provided by means of the direct current arc and incandescent lamp.

I personally lean toward the alternating system, but if we are frank with ourselves, we must admit that while the promoters of the alternating system have made very rapid strides in the last five years in the perfection of their machinery, and have overcome difficulties which five years ago seemed insurmountable, there are certain elements yet which they have not overcome, and which we hope they will overcome, and when they do we have come out of the wilderness, but the chief difficulty of the present time is in getting an alternating motor which can be used on such work as printing press work, which is exacting in the extreme: upon electric elevator work, which is one of the chief sources of revenue for central station plants, especially in large cities, and an arc lamp which will run upon practically the same energy as a direct series arc lamp. The alternating arc lamp of to-day has been greatly perfected, and is almost perfect so far as the quality of light is concerned, and absence of noise. It, however, has a slight deposit of ashes in the globe which requires it to be cleaned oftener than the direct current lamp, and absorbs or consumes somewhat more energy than the other type of arc lamp, and while it is to be hoped that these objections will be removed, and they probably will be, we have not yet reached the point where we can place them exactly on a par with the other type of lamps.

I believe that the connecting link between the present direct current station and the future alternating central station, lies in what I have mentioned before, in the combination generator. We can install machines to-day which will produce both direct current and alternating current, and which will drive our present direct current motors satisfactorily, until the time comes when the alternating motor is perfected. Then by simply taking off the commutators of the same machines, you can convert them immediately to do alternating work, without any additional expense. I believe that the central stations of the present and for several years to come, will be designed on these lines and with combination machines.

In answer to a question whether in his apparatus for condensing, he uses the same water over again, and whether he uses a jet or surface condenser, Mr. Arnold stated: It depends upon the location of the cooling tower. It is usually necessary when a cooling tower is used, on account of the value of real estate, to place it upon the roof of the building, and then by all means use a surface condenser, for, by using a surface condenser you get a closed column of water, that is, the condensing water can never come in contact directly with the steam, and in that way you avoid the danger of the flooding of your engine cylinder, which is liable to happen when using a jet condenser, if you had a great body of water on the roof and your jet condenser should fail.

The number of degrees that you can reduce the temperature of the water in the cooling tower depends entirely on the size of the tower and the speed at which you run the fan, which means consumption of energy. In winter this water leaves the condenser at about 100 deg. Fahr., and is reduced to about 65 or 70 deg. Fahr., while in summer time it leaves the condenser at about 120 deg. and is reduced to about 80 to 90 deg. You can get it as low as the temperature outside if you use power enough on the fan, but it is not advisable to attempt to get too great a reduction of temperature in that way, because it takes too much

[1] The Arnold system was described in The Engineer on May 16, 1894, and May 27, 1898, and the magnetic clutch on Aug. 11, 1898.

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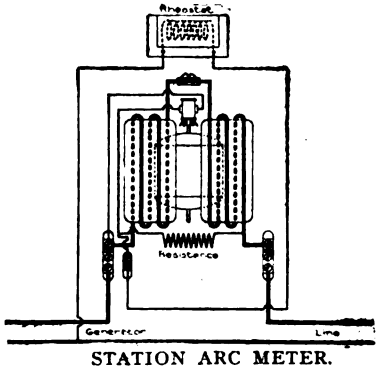
power, so that if you get down to 80 deg. in the summer time, it is sufficient, because to cool the water from this temperature down, the power required on the fan increases very rapidly.

Connections of Thomson Recording Wattmeters.

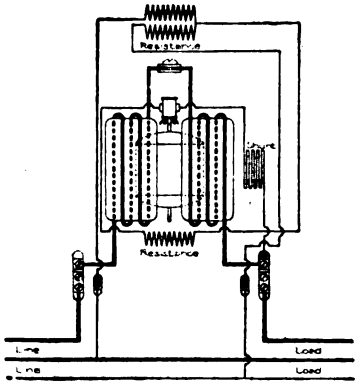
ALMOST artistic catalogue of the Thomson recording wattmeters, just published by the General Electric Co., contains diagrams of the internal connections of these instruments. The clearness of the diagrams and their grouping together, it is thought, will prove of use to many of our readers handling the various types.

It will be noted that the connections are virtually the same except in the case of meters for arc circuits, where considerable modification has been found necessary. Attention is called to the fact that all two-wire meters of less than 75 amperes have both wires from the generator or transformer brought into the meter, while meters of the two-wire form of capacities of 75 amperes or over, are designed to have only one side of the main circuit carried through the meter, the armature connection being made by carrying a small potential wire from the third or armature binding post to the opposite side of the system, as shown in the diagram of the two-wire meter.

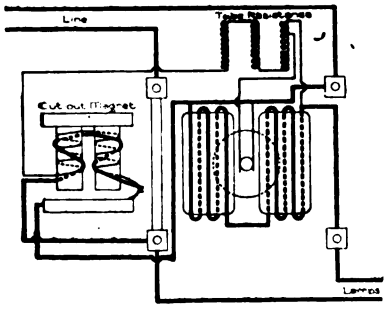
In cases where it is convenient to run both sides of the system through the smaller meters, they may be connected like larger capacity instruments, by carrying the potential wire from either of the inside posts to the side of the system opposite to that which has been carried through the meter in series. The connections shown in the diagram for three-wire meters are for the high efficiency form, and differ radically from the connections formerly used in three-wire meters. In the original form of three-wire instrument the neutral wire was not connected.



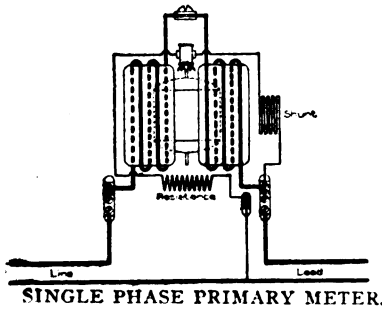
STATION ARC METER.



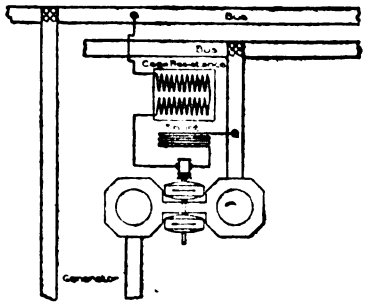
BALANCED THREE-PHASE METER.



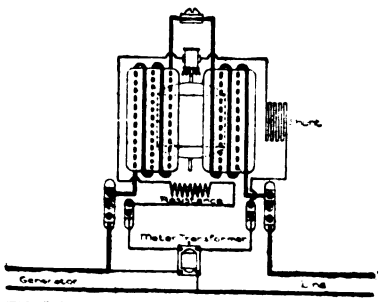
ARC CIRCUIT METER.



SINGLE PHASE PRIMARY METER.



LARGE CAPACITY STATION METER, G 2.



TWO-WIRE METER—75 TO 1,200 AMP.

Lighting at San Paulo, Brazil.

We are informed that the San Paulo Gas Co. have decided to at once erect an electric light plant for the supply of current for lighting and power. They have already entered into an agreement to light the new railway stations in course of erection in San Paulo. The Gas Company have decided upon this because of the strong position they occupy in San Paulo with the new concession for thirty years, and being in position to raise the capital without difficulty. The company's consulting engineer has been instructed to prepare the plans and specifications and obtain tenders for carrying out the work with the least possible delay.

Arc Lamp Regulation.

BY ALTON D. ADAMS.

AN engine or boiler for which a gain in efficiency of 15 per cent. over present practice could be shown, other things being equal, would find ready adoption at an increased price. A maker of large electric generators who could maintain a claim of even 5 per cent. greater efficiency than his competitors, would rightfully be able to get more money for his apparatus. But in spite of this lively appreciation of losses in some directions, there is in common use a method of electric distribution to arc lamps involving losses from 18 to 25 per cent. at the lamp and with apparently no effort to prevent the waste.

The open arc lamp with carbon points in free air is able to use about forty-five volts pressure; and the enclosed arc with globe about carbon points requires a pressure of about eighty volts at the lamp. Tens and hundreds of thousands of such lamps burn nightly in central stations and isolated plants throughout the country, with regulating coils in circuit which change to useless heat thousands of electric horse power.

As is well known, the open arcs are burned two in series on the 110-volt circuits, and the enclosed arc is connected singly to the same pressure on higher voltages, as 220 and 500; the number of arc lamps in series is increased so as to bear nearly a constant ratio to the line pressure.

In order to reduce line pressures to those required at the lamp terminals, resistances, usually in the form of iron wire, are connected in series with the lamps and are so proportioned as to require the difference between lamp and line pressures to force the lamp current through them.

Taking for example the arc lamps on 110-volt mains there is for the case of two open arcs in series $110 - 90 = 20$ volts at the terminals of the regulating resistance, which corresponds to a loss of $20 \div 110 = .18$ or 18 per cent. of the total line energy. With closed arcs, $110 - 80 = 30$ volts exist at the resistance terminals, corresponding to a loss of $30 \div 110 = .27$ or 27 per cent. These losses are so serious that they might well lead to a change of pressure to that just sufficient for arc lamps, were it not that a nearly fixed resistance in series with arc lamps is absolutely necessary for satisfactory operation on constant pressure circuits.

The office of the fixed resistance is to check current fluctuations in the lamp, which follow with each movement of the carbon points, but are limited by the rise in pressure at the resistance terminals.

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Suppose two arc lamps in series with the proper resistance on 110-volt mains to require a current of 10 amperes with normal length of arcs and that the volts at the resistance terminals are then 20. If by a drop of the carbons the amperes momentarily increase to 20, the volts at the resistance terminals will rise to 40 thus leaving but 70 for the two lamps.

In the present state of the art, the use of the above resistance seems imperative, but it is by no means certain that the resistance must remain as at present in a form which simply dissipates the electric energy as useless heat. The work consumed in regulating resistance for a pair of 10 ampere open arc lamps in the 110-volt mains is seen from the above to be at normal condition of the arc $20 \times 10 = 200$ watts, and the resistance for an enclosed arc taking 80 volts and 5 amperes, uses $30 \times 5 = 150$ watts or 300 watts for two such lamps.

For every pair of the 10 ampere open arc lamps then, enough power is consumed in regulating resistance to operate four 16 c.-p. incandescent lamps of 20 volts and 2.5 amperes each. The objections to the use of incandescent lamps in place of the regulating coil are the variable power of the light, owing

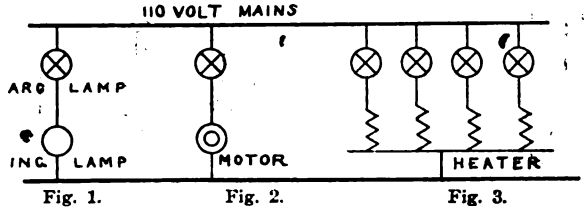

Fig. 1. Fig. 2. Fig. 3.

ADAMS ON ARC LAMP REGULATION.

to current fluctuations, and the short life of the lamps due to the same cause.

It is possible that incandescent lamps may be substituted for the regulating resistance with some types of arc lamps, where the incandescent lamps can be used for large areas or for out-of-door lighting, but this point requires further demonstration. As low volt lamps do not deteriorate as fast as those of high voltage on a fluctuating pressure, their use under the conditions noted above will perhaps be warranted in some cases; and the method of connection is shown in Fig. 1 for a 30-volt, 5 ampere, 50 c. p. incandescent lamp on 110-volt mains with closed arcs.

Small electric motors may be used with advantage to replace dead resistances in series with arc lamps, where there is any work to which the motors may be connected, such as pumping water or operating ventilating fans, but each motor should work independently of all the others, and not be connected to a common shaft. The method of connection is shown in Fig. 2.

The objections to motors for the above purpose are their variable power and speed, under required conditions, and the fact that each motor is so small as to have a low efficiency, say, 50 to 60 per cent., so that only about half the possible saving is effected. Another difficulty lies in the fact that in many instances no useful work can be found for the small motors.

The most promising substitute for the resistances now used with arc lamps is found in electric heating and cooking appliances. This change is simply one of position and arrangement of the regulating resistance, taking it from the chimney of the arc lamp or some out of the way place on the wall and arranging it at a point where it can be conveniently used for cooking or heating. In this method, all of the heat is available in a useful apparatus, and momentary fluctuations of current would have no bad effect.

It should be noted that as many separate resistance coils as desired may be combined in a given cooking or heating apparatus for the same result, the connections of each coil to its own lamp or lamps being kept separate.

Fig. 3 shows resistance coils, for four enclosed arc lamps on 110-volt mains, combined in a single heater with as many independent connections.

Central stations and isolated plants can certainly effect a considerable saving by the use of some of the above devices for regulating resistances with arc lamps wherever possible.

THE HIRAM MAXIM ELECTRIC CORPORATION has been formed in England, with a capital stock of $1,250,000, to acquire other rights than those relating to Mr. Maxim's guns and torpedoes.

TELEPHONY AND TELEGRAPHY

Experiments on Coherers.

BY ALFRED G. DELL.

THE following laboratory experiments were made by the author to determine something concerning the action of coherers. The electric wave producer employed in the experiments was constructed as follows: In Fig. 1, a is a brass plate 12 x 14 inches, swung by silk threads, f, and additional wooden supports, g, having notches with their sides filled with sealing wax; they are intended to keep the plates steady; s is the spark-

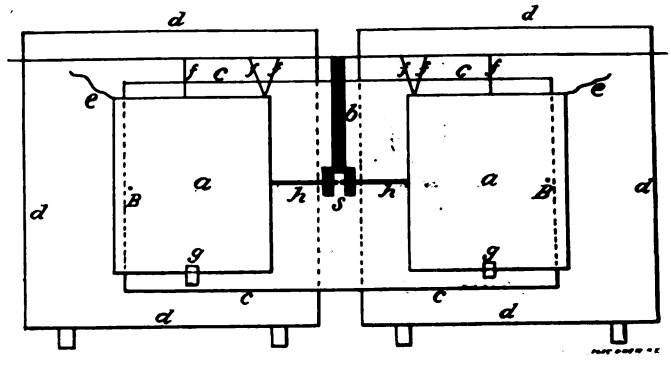

FIG. 1.

gap, the wires, h, being No. 16 stiff brass, each 4½ inches long, gold pointed at s; b is a piece of dry oak wood to keep the spark-gap in place, the holes in the wood being made large and filled with sealing wax, and then the wires forced through the wax; e is the leading-in wire from the secondary of the coil. B is a hole to attach the leading-in wire for trials of better places of their connections to the plates. Back of the brass plates, two inches therefrom, is a zinc sheet about 15 x 25 inches, represented by the letter c. Directly in front of the brass sheets, a, and the wires, h, are two zinc plates in wooden frames, one inch from the brass sheets, or at a distance sufficient to prevent sparking to the plates; they are 2 x 3 feet, being arranged to be set up at pleasure.

Without the 2 x 3 feet sheets, the electric waves were detected at a small distance; with the zinc sheets set up, I was able to spark resonating circles eight or nine times the distance.

Using as a test only one cell of battery and a coil giving with the one cell ½-inch spark between points as its maximum,

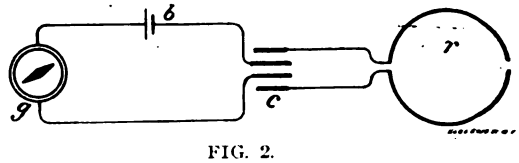

FIG. 2.

I was able to obtain sparks in a resonating circle at the distance of 40 or 50 feet. In the coherer experiments I placed the ends of four copper wires as follows, having reference to Fig. 2: G is the galvanometer; b, the battery; r, the circle of brass wire to collect the waves; c, the coherer. The part c of the wires is covered with a gilding solution sold in paint stores, the spaces between the wires being filled with the solution. It appears that the paste, when put on, is composed of a great number of metallic particles, and each particle separated from its neighbors by a thin film of poorly conducting substance. I found when the electric wave radiator was started that there was a considerable throw of the needle, taking into account the distance from the radiating plates, in addition to the throw from the natural conducting properties of the solution, but the needle remained in that position, and no tapping would bring it back

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to its original position. The conducting metallic particles are fixed, and cannot move, when put on with the solution, so there cannot possibly be any movement from tapping. I next made a coherer out of a small phial, filling it about two-thirds full with fine brass filings, and fastened through the cork two copper wires, so they were about ¼-inch apart, sealing it with wax.

I attached the coherer to a circle of brass wire broken at the opposite points of a diameter, the coherer connecting two ends of the circle, and connected in shunt with the coherer a sensitive galvanometer and one cell of battery. I found the coherer acted finely. However, some peculiarities in its action were noted. I placed a zinc sheet in front of another sheet attached to the positive pole of the secondary of a small induction coil, and grounded the other end of the secondary of the coil, and with this I obtained a plate having a heavy charge when the coil was in operation. I attached the coherer, one end to the plate in front of the one attached to the coil, and the other end to earth, and placed in shunt with the coherer the galvanometer and cell of battery as described above, but could not obtain the slightest deflection of the galvanometer needle while the coherer was cool. I then freed the end attached to earth, and let it spark to earth, and immediately there was a violent throw of the needle.

In a few seconds with this arrangement the coherer began to get warm, and commenced to conduct, the conductivity increasing with the increase of heat. There were some throws of the needle beyond its conducting condition, but it appeared the length of the throws was gradually diminishing with the heat. as the conductivity from the heat increased.

No tapping or shaking would bring the needle back to the zero point when warm. I tried a vacuum tube held in the hand in front of the zinc sheet, and found no light when connected to earth, showing the charge was passing freely to earth without radiation. When the spark to earth was made, the tube lighted up brightly, the resistance of the spark-gap producing radiation of the charge by delaying the discharge to earth.

The question then came up: Did the charge, when the plate was to earth, pass through the galvanometer coil and the battery cell, that were in shunt with the coherer, or through both arrangements?

The only test I could think of at the time, was whether the coherer would get warm when connected directly to earth, the galvanometer and battery being in shunt; if it did, there would be no doubt of the passage through it, at least partly, but if it did not, it would be no test at all, as it might be it would pass and not heat the metallic particles. I let the coherer get perfectly cold, and found it did get gradually warm when attached directly to earth.

When there is a spark in the secondary of the induction coil, the coherer acts, although one of its ends is connected directly to earth.

I also found that when the coherer by itself was attached between the break of an induction coil and its condenser on one side, the condenser acted freely, while with the gilding solution coherer, I could get nothing into the condenser at all.

I repeatedly tapped the brass filings coherer when placed between a side of the break and condenser, and was careful there should be no influence from any electric waves.

When the coherer is placed between the break on one side of an interrupter and induction coil condenser it gets hot, and there is the usual deflection of the needle connected in shunt with the coherer, a cell of battery of course being connected to the galvanometer as described above. When well tapped, the coherer does not produce any deflection of the needle of its own accord from the current of the connected cell of battery.

Not all the heat produced in the coherer came from the induction coil discharges, as I found the coherer heated up much sooner when it was connected with a primary battery than when it was connected by itself.

The following two experiments are in doubt; they may have been caused by the motion of my hand. When the coherer was grasped in the hand for a while, the galvanometer needle had a slight deflection, but returned when the coherer was released.

When a cup of cold water was held so the coherer was in the water after a deflection of the needle, the needle partly returned.

In making the ground connection in some of the experiments above described I used a switch, so I could make and spark the ground connection at will, and rapidly, and could notice the effect in an instant.

If there appear any disagreements between the experiments, I can only state I give exactly what I obtained, and when the result was negative I tried to obtain a positive one by repeated experiments. They are all the experiments I have made with coherers except that I started by means of the coherer a separate induction interrupter some 10 or 15 feet distance from the radiating plates, which seemed to be without any special interest. If my experiments throw some light on the subject, little as it may be, my object in publishing them has been obtained.

Marriage in Elmira, N. Y. by Telephone.

A special despatch of Jan. 31 from Elmira, N. Y., says: A young man and an elderly gentleman called upon the Rev. Dr. Jennings, a trustee of Elmira College, yesterday, and said they were Albert Rantz and George Maxwell, both of Williamsport, Pa. They produced a Pennsylvania marriage license and other credentials to prove their respectability. Mr. Maxwell, the elder gentleman, explained that the young man and his daughter, Miss Nellie Maxwell, had resolved to be married by telephone. Dr. Jennings hesitated, but, upon being urged, consulted a lawyer, who counselled that the proceedings would be legal. The father returned then to Williamsport, 70 miles away, and at 9 o'clock last night had his daughter at a telephone station with witnesses, while the groom, Dr. Jennings and several witnesses were at a telephone here. The ceremony was duly performed over the wire. The young man received congratulations and returned to Williamsport to-day. He did not explain why the marriage was by telephone except to say that he and the bride desired to be original. He left to-day to meet the bride at her home and will engage in business with his father-in-law.

The Telephone and Self-Reliance.

Does the telephone, asks the Springfield "Union," do away with a certain amount of self-reliance? The head of almost every large concern has a telephone at his house. Before the introduction of the telephone the head clerk or manager was compelled to make decisions in the absence of the proprietor. Now he runs to the telephone and explains the case and gets his orders. The telephone enables a man to conduct his business, to some extent, at home, because he is constantly within reach of the store.

Warren & Niles, O., Telephone Co.

The above "independent" corporation has increased its capital from $50,000 to $75,000. It has two switchboards of 500 and 200 drops, respectively, and 640 subscribers. The Keystone Electric Co. were the manufacturers of the apparatus. The rates are $12 for residences and $24 for business houses. There are over 500 miles of toll line, and a line is being laid out and contracted for from Cleveland to Pittsburg. E. J. Clapp is president of the company; W. Hyde, vice-president; H. J. Barnes, secretary, treasurer and general manager.

Telephone Short Circuits and a Small Boy.

A telephone company in an Iowa town has made an interesting discovery, and at the same time solved a mystery which has been puzzling it for weeks. The telephone lines, which had previously given good service, began a short time ago to develop all sorts of queer symptoms. The linemen had a bad time searching up and down the wires for the trouble. At length they found a spot where a heavy lead cable had received a shot from a 22-caliber rifle. The bullet had twisted and cut the wires and worked several varieties of damage. The injured section of the cable had to be cut out and spliced. Later on other bullet marks of the same character were discovered. It was evident that some one was in the habit of making a target of the wires, and as each shot cost the company about $25 for repairs the superintendent of the line was a little anxious as to who should pay the bill. He was not long in finding out. The son of a prominent resident of the town was caught prowling around an alley with a small rifle, shooting at birds on the wires, and inasmuch as one of the cables near his home was ruined by the shooting, it is assumed that the boy is responsible for the trouble that has ben bewildering and exasperating the telephone subscribers of the town. The town has determined to put in force a local ordinance which makes it just as much of a misdemeanor to shoot a target rifle within the town limits as it

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would be to fire off a Gatling gun. The town marshal has given instructions to the patrolmen to arrest any one seen going about with a target rifle, and mischievous boys are to be taught to let the telephone lines alone.

Government Telephony in England.

A SPECIAL correspondent of the New York "Commercial," writing from London on Jan. 21, says: That some alteration must be made with regard to the telephone service of this country was made amply clear by the report of the House of Commons Committee, which was issued at the end of last session. The committee reported in favor of general, immediate and effective competition with the National Telephone Co., and suggested that this competition might be undertaken either by the Post Office or by the local authorities throughout the country. The report sealed the doom of a monopoly which had failed to supply the business public with a necessary convenience at a moderate price.

The basis of purchase talked of represents the sum of £6,850,000, and this amount might be provided either out of unemployed balances in the hands of the Treasury or by the issue of terminable annuities, or by the creation of £6,525,000 2½ per cent. consols at £105 per cent. This latter course involves an interest charge of £163,125 per annum, and this is the sole tax which would remain upon the profits of the telephone system after its adoption as a Government undertaking.

The following table gives the gross, the net and the average earnings of the telephone company during the two years ending June 30, last:

	1897.	1898.
Gross receipts	£916,931	£1,046,468
Working expenses not including royalties	507,074	581,736
Net receipts.....	£409,857	£464,732

Taking the average result for the purpose of calculation, there would remain, assuming the business to stand still after its transfer to the Government, a sufficient result to cover the interest on the purchase money, and to leave an annual net profit of £265,800. If this annual net profit were placed to a sinking fund for the purpose of writing down or extinguishing the purchase there would appear to the credit of the transaction at the termination of the 13 years the sum of £4,000,000, in addition to the interest earned by the capital. The net profits of the National Telephone Co. exhibit a moderate but gradual increase—£31,000 per annum on the average of the last three years. If this progressive increase of profit be added to the net results as dealt with above, and placed to a sinking fund at 2½ per cent., that fund would stand at the termination of the 13 years at £7,000,000. It must be remembered, however, that a proportion of these profits already reached the Post Office Department in the shape of royalties, being a tax of 10 per cent. upon the gross earnings of the company, and averaging during the past three years £85,000 per annum.

To Mr. Edward Rae, of Liverpool, must be given the credit of formulating a scheme of State purchase which, superficially at any rate, has much to recommend it. Mr. Rae has done more—he has extracted from James Staat Forbes, that astute financial statistician, an acknowledgement that the directors of the National have recognized that there was such a thing as public opinion, and further, that on "reasonable and fair terms," they are prepared to bow before it. Mr. Rae's letter shows that, excluding the royalties, the estimated profits of the company, if devoted to sinking fund purposes, would in the year 1911 produce a sum exceeding £5,500,000. In that case, the Government would in 13 years have received 2½ per cent. upon their consols, in addition to the royalties, and have in hand a sum with which the purchase money might be written down to £1,350,000.

Opposition Telephony in Chicago.

Chicago correspondence says: The Council has passed an ordinance granting to the Illinois Telegraph and Telephone Company a fifty-year franchise without compensation. It passed by an overwhelming majority, including in its number Aldermen who did and did not vote for the recent traction measure. Its rates are to be $50 a year for residence telephones and business instruments in proportion. Its promoters were not named, but they have since been discovered. They are H. J. Hanford and Milo G. Kellogg. The latter is widely known in telephone circles as the inventor and manufacturer of telephones and switchboards. His patents are in use by the "outside" telephone exchanges in St. Louis, Cleveland, and Indianapolis. In the St. Louis company are some heavy stockholders among prominent men.

The local telephone field has been carefully gone over by the promoters, who have been perfecting their field notes during the past three months. They promise if the Mayor signs the ordinance that their company will put in an exchange at once. The capital stock is $5,000,000 and agreements to finance the company are completed. Only $500,000 of the stock will be subscribed by Chicago people. The remainder will be taken by St. Louis and other cities. The stock will remain in the hands of a trustee for five years, so that no stockholder can sell out in that time. It is understood that if the company will agree to reduce its franchise from fifty to forty years and will agree to pay the city a compensation after the first fifteen years, the Mayor will sign the ordinance. The old company's franchise expires fifteen years from now, and if it should desire an extension a uniform rate of compensation may be agreed upon at that time.

Telephonic Developments in Michigan.

Members of the executive board of the Michigan Telephone Co., consisting of Chas. J. Glidden, Asa C. Russell, James W. C. Pickering, James H. Mills, David S. Greenough, John C. Burke and Frederick A. Forbes, have been making a tour of inspection. The new interest is now represented in the Michigan company's board of management by the way of an addition to the executive force. All of the present management will be retained and heartily co-operate with the new acquisitions in all respects. The policy of future development is being rapidly determined, one important feature being the establishing of the northern division of the company, including the entire upper peninsula, with a general superintendent's office and headquarters at Marquette. This division now consists of twenty-five exchanges and over 2,600 subscribers. All the exchanges will be connected together by the long distance lines to Chicago, Detroit and all telephonic points.

The development will be of a strictly permanent character and the best that can be established to provide for perfect long distance and exchange service. The company will purchase land and erect a building at Marquette for their division superintendent's headquarters and local exchange. The improvements around Traverse City will consist of new switching apparatus and the construction of several copper metallic circuits to the upper peninsula, Grand Rapids and other points of the State. The entire upper peninsula will have three outlets, one via Negaunee, Menominee to Milwaukee and Chicago; another via Mackinaw City and Traverse City, another via Bay City to Detroit. Sault Ste. Marie will be connected with Detroit via St. Ignace and Mackinaw City. The island of Mackinac will also be connected with St. Ignace by a six-pair heavy submarine cable. This quality of cable will also be used between St. Ignace and Mackinaw City; number eight copper will be used between all long distance points; the conversation from the extreme northwestern end of the peninsula and Calumet to all points will be perfect.

The Strain on a Telegraph Operator.

AS regards diseases of telegraph operators, Mr. Hull, president of the Railway and Telegraph Workers' Union, of England, states that their pursuits exposed them to a great number of maladies, and that their work was of the most dangerous kind.

Every one knows that the telegraphist reads better with his ears than with his eyes. He carries out an essentially mental operation by using the nerves of hearing. This faculty is consequently highly developed in his case. In the ordinary work of reading twenty words a minute the telegraph operator must distinguish 150 alternate strokes or intervals, and when there is a rush of work this figure can go as high as 450. There is also the work of transforming the sounds into visible symbols, or writing, which implies another mental process. And whereas the normal amount of varied sensatory impulses per minute is 120, the telegraphist has to accomplish 150 to 450. Without taking extreme cases into consideration, it may be said that the sense of hearing in a telegraph operator is two and a half times more powerful than in an ordinary individual. Again, in tele-

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graphy the continuity of the nervous stimulation, the monotony of sounds and the fixity of attention are further causes of exhaustion. It is found also that during forced work the telegraphist's breathing is affected, his heart's action precipitated and his brain congested.

As a result of these phenomena it is noticed that a general decline of the organism follows, ending in tuberculosis. According to Mr. Hull, the death rate among men for tuberculosis is 13.8; that of telegraph operators is 46.6, exceeding by 13.5 the mortality among moulders.

And what is true of tuberculosis applies to other affections of the respiratory organs. The general death rate for the latter is 3.5, but it rises to 18.4 among telegraph operators between fifteen and twenty-five years of age, to 23.1 between twenty-five and thirty-five years of age, instead of 4.9, and to 12, instead of 5.3, between the ages of thirty-five and forty-five. From forty-five years and upward it declines, being 4.3, instead of 5.3; but this diminution is very delusive, seeing that it is due to the elimination of the weak members who have died off in the preceding years. It becomes more marked with increasing age. Between fifty-five and sixty it stands at 0.5, instead of 5.4, and above sixty-five at 0.4, instead of 8.2.

But these are not the only affections to which telegraph operators are liable. The nervous tension which they endure often gives rise to a state requiring immediate withdrawal from their work.

Reduction in Cable Rates to the Netherlands.

The Commercial Cable and the other companies announce that on and after March 1 next the rates to Holland and Belgium will be the same as the rates to Great Britain, France and Germany, the Holland rate being reduced 7 cents per word and the Belgium rate by 5 cents a word, the rates from New York City and vicinity and places east thereof being, on and after the date mentioned, 25 cents per word.

Mr. B. J. Arnold on Modern Apparatus.

REFERRING to the editorial in your issue of January 26, regarding my address before the Northwestern Electrical Association, I regret that the address and your comment could not have appeared in the same issue. I spoke extemporaneously from headings, and believe that if you had carefully examined the stenographer's notes, and taken into consideration the general arrangement of the subject as outlined, you would not have come to the conclusion you did.

To a man whose position on the storage battery question has been as emphatic in its favor as mine has been for the past five years, and who has risked not only his professional reputation to advocate the use of batteries, at a time when to do so was considered heretical professionally, and in order to prove the correctness of his ideas, has risked his fortune and the fortune of his friends, the inference to be drawn from your editorial, to the effect that I am not in favor of batteries, is somewhat surprising and chagrining.

In a paper read by me before this same association on June 19, 1894, at St. Paul, Minn., I used the following words: "While Europeans have recognized the advantage of the use of accumulators as auxiliaries in central station work, we have been slow to see the advantage, but the tendency of many American engineers and central station men is to look with favor upon this adjunct, and as there are many cases wherein the battery plant as an auxiliary, can be made to pay well, the probability is that we shall see in the next five years many such plants installed."

And in the discussion of this paper, in answering dissensions from my opinion, I used the following language: "I certainly will not apologize to this convention for speaking of accumulators as I did, because I think that if you are not convinced now that you will be inside of two or three years."

I have advocated the use of batteries, where conditions were favorable for their adoption, before the American Street Railway Association, before the American Institute of Electrical Engineers, before the Western Society of Engineers, and in technical lectures, to such an extent that I thought my position was well known on this subject, and the fact that since my paper of 1894, almost every large Edison station in this country has adopted batteries as auxiliaries, and a number of surface electric railways, and one large elevated railway, are now using them, the combined investment in batteries in the United States alone being probably $2,000,000, I feel that I am justified in thinking that my prediction of 1894 has been fairly well fulfilled.

While I passed briefly over the storage battery in my recent paper at Milwaukee, I did so, not for lack of faith in batteries, but because I had previously thoroughly discussed their advantages before this association, and further from the fact that its members were thoroughly familiar with the arguments for and against batteries, it having now become popular to advocate their use.

I am not in the employ of any battery interests, and speak simply as an engineer whose opinion is in favor of batteries after having had sufficient experience in their manufacture and use to warrant this opinion.

In my address I divided the parts entering into a power station under two classes, as will be seen from a careful reading of the paper. First, those parts which have been accepted by almost all engineers as common to all first-class power stations, and second, those parts which enter into the construction of different power stations where conditions are favorable for their adoption, but have not yet been considered by engineers as accepted practice for all conditions. Under this class I placed not only batteries, but economizers, motor-driven auxiliaries, rotary converters, boosters, etc., etc., each of which has its proper place, but no one of which can be considered by engineers as accepted practice for every power station.

Regarding the alternating current motor, I do not dispute that it may not be successfully operating electric elevators, but I have never yet had the good fortune to see one operating on such work, except when so arranged by means of belting or gearing as to run continuously, and shall be pleased to revise my opinion on this subject as soon as I am convinced that this motor will do elevator or printing press work as satisfactorily as the present direct current motor.

BION J. ARNOLD.

Chicago, Jan. 31, 1899.

(We are glad to correct any injustice done Mr. Arnold by our comment on the matter as it reached us. His revised address appears in abstract in the present issue. Eds. E. E.)

Municipal Lighting at Crawfordsville, Ind.

A special despatch from Crawfordsville of Jan. 18 says: Several years ago the city of Crawfordsville, at an expense of about $100,000, put in an electric light plant of her own, running the plant of a private corporation out of business. The municipal plant was built in an extravagant manner, and when it began to be operated the mistake was made of giving something for nothing. The city wired houses and business blocks free of charge, and established a ruinously low rate for its service. As a result, the service was soon all taken, and the plant was found to be inadequate for the demands made upon it. The price of service was finally raised, but the revenue derived from the municipal lighting failed to pay for the cost of the street lighting, as the champions of the municipal ownership of a light plant had argued.

The matter has been dragging on in this way for several years, and the time has now come when Crawfordsville, in order to get even with the light plant, has to increase its capacity at a great expense, or sell out and abandon municipal ownership. A committee from the City Council has been appointed to investigate and report which horn of the dilemma it is advisable for the city to take. It is not unlikely that the plant will be offered for sale, as many of the Councilmen fear that it will arouse public anger to expend more money on what has become popularly considered to be a white elephant.

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THE

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The South Side Elevated R. R., Chicago.

ONE of the most remarkable statistical documents in modern electrical engineering practice is the annual report of Pres. Carter, of the South Side Elevated R. R. of Chicago. Annual reports are only too frequently a conglomeration of figures unintelligible to those not initiated in the art of financial computations, and devoid of any comparative data for the guidance of directors and stockholders. In contrast, however, to such reports, many of which have come to notice from time to time, is that of Pres. Carter, printed in abstract elsewhere in this issue, which is a masterly review of the first year's performance of the Sprague multiple unit system on the Chicago elevated roads. Besides embodying many valuable tables which reveal a most prosperous state of affairs, the report abounds in valuable suggestions and conclusions, based on the tables as well as upon close observation and study.

The road, whose routes and equipment were fully described in The Electrical Engineer of May 5, 1898, and later, was operated by steam power from Jan. 1 to April 20, 1898. From that date until July 27 the operation was partly by steam and partly by electricity, the change from one to the other being gradual and necessarily involving the additional expense of maintaining two systems. Since July, 1898, the operation has been entirely by electrical power. The months of November and December, 1897 and 1898, however, are the first strictly comparative months. The road then included the "loop" operation, 19.44 miles of track, which in 1897 was operated entirely by steam, and in 1898 entirely by the Sprague multiple unit electric system. In addition to all "loop" expenses there is a rental charge equal to 10 per cent. on the gross passenger receipts of the road. This should be considered really as an interest charge, not as an operative expense. For these two months the comparative table following shows: (a) Ratio of expenses to earnings, including "loop" rental, taxes and licenses; (b) ratio of expenses to earnings, excluding "loop" rental, but including taxes and licenses; (c) net earnings.

	(a.)	(b.)	(c.)
November, '97, steam.....	87.3	77.7	$10,603.80
" '98, electric	57.3	47.7	39,448.56
December, '97, steam	83.6	73.8	14,691.69
" '98, electric	55.0	45.4	45,355.68

"It appears," says Pres. Carter, "that the cost of operation has steadily decreased, month by month, partly because better results have been, as is usual, obtained from the power house after a few months' use. The cost of operation for the entire year was 69.3 per cent. This includes the loop rental of ½ cent a passenger and the company's share of the cost of operating the loop. Not including the former the cost of operation was 60 per cent."

The earnings for 1897 were at the rate of a little more than 1 per cent. on the capital stock; for the first half of 1898 at the rate of 1⅞ per cent., and for the last half of 1898, or the first six months of electrical operation, at the rate of 3½ per cent. on the capital stock. This speaks highly for the management of Pres. Carter and the efficiency and fitness of the Sprague system. The good judgment of the directors is evidenced by the fact that the above net earnings on the capital stock are to be expended on improving the earning capacity of the road and meeting the demands of the public for increased facilities for travel without increasing the indebtedness by the issue of bonds.

The increase in the number of passengers carried during the first ten months of the year, as shown by the table, is certainly a phenomenal one, the lowest being a 47 per cent. increase in February, and the highest 63 per cent., in July. Another feature worthy of note is the gain in November and December over the corresponding months in 1897. In those two periods the conditions were practically the same—that is, the full use of the Union loop had been enjoyed. The increase, therefore, of 9 per cent. in the traffic for November, and 10 per cent. in December, over the corresponding months of 1897 apparently indicate the rate of annual improvement which may be fairly expected so long as business conditions remain as they are. This is the belief of Pres. Carter, who also considers this 10 per cent. growth one which should be very satisfactory to the shareholders.

In speaking of the cost of operation of the plant, the economy in which is largely responsible for the creditable showing referred to above, he points out that the operating expenses based on maximum power required of 8,000 horse power for about four hours each day in the winter months, is about $8 per h. p. per annum. Adding to the above general expenses, 10 per cent depreciation, interest, insurance, and taxes, the total cost per maximum h. p. per annum does not exceed $15.

Many kind things are said by Pres. Carter about the Sprague system, among which is the following: "We believe that the system has fulfilled expectations. Exhaustive tests have proved the economy of rapid acceleration and long coasting. A schedule speed of fifteen miles per hour is easily maintained, and time lost is easily made up. If needed, in order to meet competition, the speed of the trains can be increased to twenty miles an hour. The reliability of the system has been fully tested this winter, when 150 cars, all we had, were in daily operation (Sundays excepted), for many weeks. The advantage of the flexibility of this system on crowded days, for switching and changing the length of trains, is apparent."

During the year an important step was taken, the wisdom of which has since been fully established by the results obtained, in the establishment of two battery plants of 750 k. w. capacity each, which have greatly reduced the fluctuations in the power house. In the words of Pres. Carter, "They keep up the voltage at the ends of the line, enable the road to operate more cars, furnish increased facilities to patrons and prevent damage to power-house machinery in case of sudden demand for increased power."

Little but praise for the foresight and progressiveness of the company can be added to the eloquent figures contained in Pres. Carter's noteworthy report, with a wish for a growth of the road's prosperity. The record for 1898 stands as an invincible argument in favor of electric power for elevated roads, and we hope will serve as a final argument to drive out of existence at an early date, antiquated men and obsolete methods on the elevated roads of New York.

A Cable to Manila.

AS might have been expected, President McKinley has called the attention of Congress to the immediate need that exists for a direct cable to Manila. At present, all our cable news from the Philippines comes by way of Asia and Europe, and must do so until the Pacific is spanned by a cable from our own shores or from the Canadian coast. Preferably it should run from the United States, but the exact landing is a matter of indifference, so long as we get it. Congress should vote a liberal subsidy for an all-American cable touching at the Sandwich Islands and Guam. And even then, as Mr. McKinley points out, it will be two years before the cable can be fully laid, from the time it is ordered. For two years past we have been urging just that fact, and this country might just as well have had its direct Manila cable to-day as a direct aid in our

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fight with Aguinaldo and his Malay pirates and in our endeavor to give tranquility, prosperity and liberty in its true sense to all the inhabitants of the Philippines. Congress cannot act too quickly on this matter. It is some relief to know that even now a cable expedition is rapidly fitting out to link up at once the principal islands, in order to facilitate the work of establishing our headship in the new colonies.

Automobiles and Human Character.

IT had to come sooner or later—the indignant protest from some lover of the horse against the automobile tendencies of the age—and now our very excellent friends of the "Western Horseman" ask to be allowed to depart in peace before the horseless age begins. They want to know if we have no childhood days to recall; if we have no children growing up around us; if we remember that of all the animals created by an Infinite Being the horse and dog alone are endowed with affectionate natures and the spirit of enthusiasm. Well, though growing bald, we will say for ourselves that we do look back on some happy childhood days that had no horse in them, as well as on some that had. We plead guilty to one child of our own, but he has taken so far more interest in pet turtles and mice and in his wheel than in any Shetland pony yet brought to his notice. Although added years may change this, we don't exactly see what it has to do with the case. As for the claim of the horse and dog to moral superiority, we dispute it flatly. The dearest friends we ever had personally in the animal world were an elephant and a monkey; and their equals for sweetness of temper and general good-fellowship have never been seen. It is possible that Mary's pet lamb may have been better company for little girls, but we are thinking rather of animals with the "spirit of enthusiasm" in them, good company for boys and men.

But this is not all. It is not enough that we should differ from our Western contemporary about the intellectual loveliness of Mexican plugs and Sandy Bar bronchos. Such differences of opinion are personal, temperamental. We have never lavished affection on one of Buffalo Bill's buckers, but we can readily imagine our contemporary being ready to die for one of them, or perhaps because of it. But the "Horseman" goes further, and challenges the ability of the automobile to assist in the formation of higher human character: "Can a motocycle form character or develop the latent instincts of a boy? Inanimate objects are not teachers of youth. They never have aroused sentiment, brought experience or knowledge of the right kind; neither are they named in the Decalogue. Experience gained through the use of the motocycle is not calculated to develop character or mind." Now, fancy that! Our friend evidently has not read Kipling's moving ballad: "How the Auto Found the Curb," which, as expressive of the sentiment in "inanimate" things, is certainly as fine as any of his pieces about locomotives and steamships.

But to be even more serious, and to examine this question with care. The cold weather of the past week throws some light on the subject. Those of us who have lately watched teams of eight and ten horses hauling snow sweepers on car tracks would hate to see them deprived of that affectionate and enthusiastic occupation, but it does seem to many that the men are more merciful who seek to exclude horses from the dissipating excitement of such a luxurious career. Last Thursday night a horse attached to a cab just outside the Waldorf-Astoria froze to death because its bosom companion, the driver, had omitted to put a blanket over it. Other horses all over New York city suffered and died, but of course it would not be fair to deprive their owners of the charm of such chilly though inspirational equine society. The horse may suffer, but the man would suffer more not to see him suffer, and all this elevating influence would be lost. Meantime, the automobiles have been in demand because they are warmed, and the drivers while waiting have ensconsed themselves snugly within, surly only because the horses that formerly shaped their tempers no longer stood in the keen and biting blast, evidences of man's kindly humanity to one of his best servants.

Yes, it is true that animals help form character. We were witnesses in court once in a case where a drunken driver, encouraged in his intemperate habits by the untutored connivance of his horse, charged headlong while asleep into an omnibus and scattered his coal and its passengers over two city blocks. We believe that many teetotal advocates oppose horses because they are so weak in this respect, and that to the indulgence of the horse they ascribe much of the drunkenness of our times, and much of the dangers of the streets. It is pitiful, but true. On the other hand, we are told that driving an automobile, like riding a bicycle, is a great incentive to sobriety, and our own practical observation of automobile drivers confirms us in the conviction that bibulous, red-nosed Jehus must go, sad as the parting with them will be. It is also a fact, demonstrable by all literature in all times, that horse trading—to say nothing of racing—is a terrible temptation to dishonesty, or stimulates horribly the desire to get the better of fellow-man. But in the case of the automobile, an "inanimate" thing of rubber and steel, we are reduced to the bare blandishments of a mathematical price list, and miss the thrilling excitement of obscure cheatery. Now, whether that is a loss or gain, depends also on the point of view. But when it comes to swearing, surely all will admit that the automobile is likely to do more than Guggenheimer to purify the inarticulate speech of maddened humanity. Horses and mules the world over have the proud distinction of doing more to engender "cuss words" and develop damnatory onomatopoeia than any other beings of affectionate nature and enthusiastic spirit. Now, all of us, more or less, recognize the futility of swearing at frozen pipes, smoky stoves and leaky boilers; but it is a fair contention that bicycles and automobiles may be easily nobler among the "inanimate" influences making for greater cheerfulness of temper, purity of speech and higher development of manhood than all the horses, dogs, pigs and cats that man has caught fleas and diphtheria from since life on this globe began. As the "Horseman" kindly but sorrowfully intimates, we shall get along with a shorter Decalogue when the automobile comes in.

A New Reason for Subways.

CINCINNATI has discovered a new reason for putting all the wires underground, a reason that certainly cannot be said to have been obvious in other cities. It appears that on some of the busiest and most important streets, the sparrows perching on the telegraph and telephone wires have become an intolerable nuisance. A recent visitor to the city informs us that not only was he struck by the marvelous concourse of sparrows, but noted the fact that their noise was greater than that of the street traffic, rendering conversation on the street well nigh impossible. The Cincinnatians have been discusing various remedies, but undergrounding the wires is evidently the best. One curious remedy is that of playing on them with liquid poisons by the chemical fire engines of the city, a plan actually intrusted to the city fire department for execution. We have heard before of the interruption of circuits by denizens of the tropical jungle, but it may be doubted whether the circuits themselves have ever before bcome a nuisance on account of the birds that perched on them.

The Electrolytic Interrupter.

IT is not often that we deem it necessary to draw special attention on this page to any particular device described in our columns, but we cannot help pointing out the importance of the new Wehnelt electrolytic interrupter, an account of which appears elsewhere in this issue. If all that is claimed for this device is true, it constitutes one of the most valuable adjuncts of the laboratory as well as of practical everyday electrical work that has been brought to notice in a long time. Its great simplicity is not the least of its merits. Aside from general applicability its special use in X-ray work alone will be hailed with delight. The best induction coil breaks of to-day are still far from perfection, while all of them involve moving parts, and the majority require to be motor-driven. To replace all this more or less complicated apparatus by a simple electrolytic cell is no mean achievement. It remains to be shown to what extent the Wehnelt break possesses the qualities of uniformity, or rather steadiness of action under a given set of conditions. If it possesses these attributes, there is every reason to believe that it will find a wide application in the electrical arts, and be useful for purposes which inventors and engineers will not be slow to recognize. Several fields could at once be indicated in which it would find immediate adoption, given the conditions stated above.

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Gravity-Electrolytic Processes for the Production of Caustic Soda.[1]

BY G. H. ROBERTSON, F. C. S.

PROCESSES for the production of bleach and caustic soda by the electrolysis of a solution of common salt are exceedingly numerous, but it is evident from the attention which the matter still receives at the hands of inventors that a thoroughly satisfactory solution of the problems involved in conducting this operation on a commercial scale has not yet been obtained. In the early days, effort was mainly directed to obtaining a satisfactory diaphragm which should keep the anions and cations, separated by the current, from recombining. Then the anodes were thought to contain the key to the situation, and much ingenuity was expended in endeavoring to cheapen the cost of their production, and render them less destructible by the products of electrolysis. But it was realized at last that what was wanted was some method for removing the anions and the cations from the bulk of the solution as fast as they were separated by electrolysis, and in order to effect this Kellner introduced his well-known process in which a moving mercury cathode combines with the alkali metal as soon as it is released, and transfers it to a second vessel containing water, in which the metal forms caustic soda, while the e. m. f. due to this reaction goes to aid the e. m. f. which is required to decompose the salt solution. Other processes of this kind have been introduced, but mercury is costly, and there are other objections to its use, so attempts have been made to devise processes in which the continuous separation of the anions and cations should be effected by the force of gravity instead of that of chemical combination. The latest of these is that which has been recently introduced by the Oesterreichischer Verein für Chemische und Metallurgische Produktion, in Bohemia. Before describing it, it may be as well to give a short account of the principal processes of the kind which have preceded it, and the disadvantages from which they are alleged to suffer.

The earliest of these was that devised by Cuttens in 1892. He employed a pump to remove the chlorine as soon as it was formed, while the caustic solution which is formed round the walls of the cell (cathode) was allowed to sink to the bottom by its own gravity, from whence it could be drawn off at intervals. During this process, strong salt solution is forced into the lower part of the cell at a point below the cylinder which surrounds the anode, and ascending this, it leaves the upper part of the cell to be strengthened by passing over rock salt. In this process the layer formation of the electrolyte due to the difference in density between the anions and the cations is destroyed, owing to the disposition of the anodes, and the way in which the electrolyte is fed in, and the projection of the anodes contracts the space in which the layers can be formed.

Four processes were introduced in 1893. G. Baily and M. Guthrie suggested a process in which a pair of very porous screens were interposed between the anode and cathode so as to enclose a space into which the electrolyte was fed continuously, and overflows were arranged near to or behind the electrodes. The electrolyte was intended to flow from the centre to the electrodes at such a rate as to prevent diffusion, but there was a difficulty in effecting this, and the solutions of different density into which the liquid was separated by electrolysis would not maintain a vertical position, but tended to form horizontal layers with consequent intermixture.

Hurter, Auers and Muspratt introduced a density process, but the apparatus hinders the formation of layers, as, owing to the position of the anodes and the use of the whole of the cell wall as cathode, the evolution of gas from anode and cathode must generate movement of the liquid which will destroy layer formation. Moreover, the process was primarily devised for discontinuous working, and no means were provided for introducing fresh electrolyte into the closed anode compartment, so that if the process were worked continuously with the apparatus described, fresh electrolyte would have to be introduced into the open cathode compartments, which would of necessity break up the layer formation, while the liquid in the anode compartments would become poorer and poorer, with the result that secondary decomposition of water would take place with useless consumption of current.

Richardson, in order to overcome the disturbance of the electrolyte caused by the escape of chlorine gas generated near the bottom of the anodes, proposed to interpose horizontally between the electrodes a screen of slips of glass which overlapped like the slats of a Venetian blind, leaving spaces between them for the passage of the current. The caustic solution collects near the cathodes at the bottom of the cell, and as the process is not arranged for continuous working, the whole of the alkali formed cannot be removed before fresh solution is run in.

Dr. W. Bein brought out a discontinuous process, and arranged the anodes and cathodes side by side in special divisions of the decomposing trough, which communicated under the surface of the liquid. By means of a device the two layers of liquid can be separated, and the operation stopped when the electrolysis has proceeded so far that the cathode liquid is about to enter the anode compartment. The process requires careful supervision, and, moreover, the complication of the apparatus involves technical difficulties. In 1897 this process was rendered continuous by substituting means for continuously supplying fresh electrolyte to the cell at the place where in the older apparatus the valve was situated which maintained the separation of the liquid into layers, and in this way a separating layer is maintained between the anode and cathode liquids. Moreover, the electrolyte thus introduced caused the anode and cathode liquids to move to their respective outlets at a rate proportional to its flow. The advantage which it was hoped to attain by this apparatus—i. e., a continuous working—is not realized, since the admission of fresh electrolyte into the space between the anode and cathode is not favorable for the formation of layers, and it is impossible in practice to so regulate the efflux from the anode and cathode compartments that the quantity flowing away from each shall be in constant proportion, and, in consequence, the working is very irregular. If the influx into the anode compartment be restricted, the liquid therein soon becomes so dilute that secondary decomposition of water ensues, and there is useless consumption of current.

In 1894, Carmichael designed an apparatus based on much the same principle. He employed a specially designed diaphragm which afforded a free communication between the anode and cathode compartments, and the fresh electrolyte was fed in between the anode and the diaphragm so that the alkaline solution passed through to the upper part of the diaphragm, and flowed back through the communication in the diaphragm into the cathode compartment, and thence to the outlet. In addition to the disadvantage occasioned by the use of diaphragms, this process suffers from the defect that the introduction of the electrolyte into the space between the electrodes destroys the layers formed by the separation of the electrolyte into solutions of different density, and the impoverishment of the anode liquid and the consequent waste of current are not avoided.

It is claimed that the new density process, which has been recently introduced by the Oesterreichischer Verein differs from those already described, and avoids their disadvantages. Now, when an alkaline solution, particularly a chloride of an alkali, undergoes electrolysis, there is a constant passage of hydroxyl-ions towards the anode compartment, while the product of the reaction of the cations with the water collects as an alkaline solution around the cathode, and gradually spreads to the anode compartment; and if the electrolysis is carried too far, the alkali formed around the cathode spreads to the anode liquid, and chlorate is formed which gives rise to injurious secondary reactions. When the alkaline solution has a higher density than that of the electrolyte, and than that of the liquid in the anode compartment, it is obvious that the anode should be arranged at a higher level than the cathode, whereby full use is made of the difference of density between the anode and cathode liquids for separating them, and with them, of course, the products of the electrolysis. By the introduction of fresh electrolyte above the anode, and the consequent circulation of the electrolyte in a direction opposite to that of the migration of the hydroxyl-ions, the layer formation is not interfered with, and the alkaline liquid can be withdrawn from an overflow pipe. These principles are embodied in the new apparatus in which the electrodes are placed side by side, and, if necessary, at different levels. The anode is covered by a bell which extends below it, and fresh electrolyte is fed into this compartment continuously, while the

[1] "The Electrician," London, Jan. 27, 1899.

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alkaline lye produced is continuously removed from the cathode compartment, and the layer formation of the anode and cathode liquids is maintained without the use of a diaphragm, so that the products formed at the electrodes are continuously separated. How far the anticipations formed of the new process will be verified in practice remains to be seen.

MISCELLANEOUS

Latest Progress in the Application of Storage Batteries.[1]—III.

(Concluded.)

BY JOSEPH APPLETON.

METROPOLITAN STREET RAILWAY CO.'S PLANT, NEW YORK.—One of the most interesting and important storage battery installations recently made is that in connection with the underground trolley system of the Metropolitan Street Railway Company of this city. Their system covers a large area, and they have utilized storage batteries in sub-stations. Two are now in operation, one at the foot of West Twenty-third street and the other at Thirty-second street and Fourth avenue.

The battery consists of 540 cells, each containing 51 plates, 15 inches square. The dimensions of the cells are 4 ft. x 21 in. x 24 in. The battery is divided into two sections, 270 cells in each which are operated in parallel. This is done to keep the sizes of the cells within practical limits and to enable them to be more easily inspected and cared for. A cell 8 feet in length, which would be the size if but one battery were used, is too large to be satisfactory. The capacity of the complete battery is 8,000 ampere hours, with a one hour rate of 4,000 amperes.

The function of this battery is to take care of a portion of the morning and evening peaks, and to take up the fluctuations of load at all times. The method of operation is as follows:

Sufficient cells are provided so that the voltage of the battery just balances the average voltage of the system; consequently when the battery is connected to it, it acts as an equalizer and does not charge or discharge except as the fluctuations occur. When the battery discharges on a peak and is being charged during the hours of light load a booster is connected in series with it to regulate the amount of a charge and discharge. The output of the booster and consequently the charge and discharge of the battery is controlled by varying the strength and polarity of the shunt field. This is done by a special form of switch which makes the operation very simple. From 7 to 9 a. m., it discharges on the peak. From 9 to 12 it floats on the system as an equalizer. From 12 to 3 or 4 p. m. it is charging. From 4 p. m. to 8 p. m. it discharges on the peak. From 8 to 12 midnight it is floating on the system, and after midnight the battery is given its principal charge, this being continued until the battery is full.

THE USE OF STORAGE BATTERIES IN OFFICE BUILDINGS, STORES, ETC.

The modern office building, with its fifteen or twenty stories, together with the demand for quick elevator service has greatly increased the use of high speed electric elevators.

The nature of the work the elevator has to perform, and the fact that the power required to start it is from two to three times the hoisting power, causes the elevator load to be an extremely fluctuating one, no matter how carefully the operation is watched.

THE COMMERCIAL CABLE BUILDING, NEW YORK.—This is an excellent example of what can be done with the operation of an electric plant of this description. The building is wired for about 3,500 16 c. p. lamps, 240 volts, and has six screw type high speed Sprague elevators. The generating plant consists of two 300 h. p. water tube boilers, two 225 h. p. engines directly connected with two 150 k. w. generators, and the storage battery consists of 120 cells, each containing 27 plates, 15½ in. x 15½ in. The capacity of this battery is as follows: At 260 amperes, 1,620 ampere hours; at 520 amperes, 1,040 ampere hours; at 650 amperes, for the one hour rate.

The function of this battery is to take care of the fluctuating elevator load during the day time when the plant is running, that is, between 9 a. m. and 9 p. m. and at night to supply the whole current required for lighting, and the occasional trips of one elevator.

Before the battery was installed it was found necessary to run one generator for the lighting circuit and one for the elevator circuit, the fluctuations of the latter causing the lamps to be unsteady if both were run from the same machine. The method of operation is as follows:

The elevator circuit is connected directly across the terminals of the battery, and the battery is being constantly charged by means of a constant current booster, which boosts the current from the lighting generators. By a special winding on this booster, the amount of current which it allows to pass from the generator to the battery and elevators is maintained practically constant.

For example, with a fluctuation of 600 amperes in the elevator circuit, the load on the generators is increased by about 50 amperes, or less than 10 per cent.; this amount having no effect on

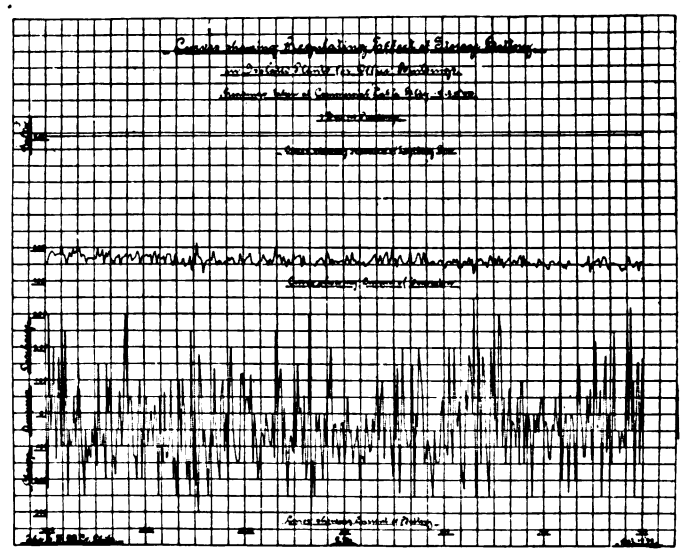

FIG. 6.—CURVES SHOWING REGULATING EFFECT OF STORAGE BATTERY IN COMMERCIAL CABLE BUILDING, NEW YORK.

the steadiness of the lamps. The amount of the current boosted in this way is the average elevator load for the time the plant is running plus the amount of current required to charge the battery after it has carried the previous night's entire load.

The curves, Fig. 6, show graphically the operation of this plant. The lower curve shows the fluctuating load on the battery which varies from 350 amperes discharge to 300 charge. Of course, when there is no elevator load, which occasionally happens (all the elevators standing still) the entire amount of current passed through the booster is used for charging the battery. When a heavy elevator load comes on this boosted current is diverted from charging the battery into the elevator circuit, the battery discharging in parallel with it as may be required. In this installation the booster is passing about 250 amperes, thus when the battery was discharging at 350 amperes the total elevator load was 350 plus 250, or 600 amperes. The second curve shows the variation of load on the generator at the same time. This, you will notice, reaches the maximum of 70 amperes, while the voltage on the lamps is maintained practically constant, the curve being almost a straight line. Such an application is an ideal one for a storage battery, as it not only decreases the size of the generating plant required, but enables the generating plant, when it is running, to be operated at a steady and economical load, instead of a fluctuating one.

The centralization of generating plants, and their location in districts where the facilities for obtaining coal and water are good, has developed. The system of high tension alternating transmission and the distribution of direct current through rotary converters, this seems to be the one which will be employed in most of the large engineering undertakings to be solved during the next few years. The advantages of direct current for distribution over the alternating are so marked that at least until further improvements are made in alternating current distribution, the direct current will undoubtedly be the one most

[1] Abstract of paper read before the N. Y. Elec. Society.

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generally used. With this system of large central power houses and sub-stations for distribution through rotary converters, storage batteries are almost essential. They reduce the size of the generating plant in the first place, and also the size of the rotary converters, and enable them both to be operated with a much greater load factor than would be possible without.

The installation of the Hartford Electric Light Co. was the first of this description in this country, and has proved the many advantages which were claimed for such a system.

An interesting application of this sort has recently been made on a small railroad plant in Montpelier, Vt. This plant was, I believe, the first railway plant in this country, operated exclusively from rotary converters with a storage battery auxiliary. The line operated is about 9 miles long, and the sub-station is located about three miles from one end. The power is furnished from a power house on the Winooski River, the current being generated by three-phase alternators at 2,200 volts. This current is carried to step-up transformers and is raised to 6,300 volts. At this pressure it is carried to the sub-station, a distance of eight miles. In the sub-station step-down transformers reduce this to 480 volts, at which pressure it is fed into the rotary converter. The capacity of this converter is 160 kilowatts, and is specially wound for running directly in parallel with a storage battery, its characteristic curve being similar to a shunt-wound generator. That is to say, as the load increases, its voltage would fall. By this means the battery will take care of all fluctuations, maintaining a fairly constant load on the rotary. The battery consists of 248 cells, each containing 11 plates 10 inches square. The one hour rate of this battery is 200 amperes and the maximum load on the line is 300 amperes. Of this the rotary carries 125 and the battery 175. The greatest amount of variation of load on the rotary is 50 amperes, while the variation of load on the line is nearly 300 amperes. Such an installation shows clearly the advantages of battery regulation on a fluctuating load. The size of the rotary is reduced by practically one-half and the load on it kept almost constant.

Most of the plants dealt with in this paper have been those of a large size, supplying a large amount of energy. It must not be imagined that storage batteries are applicable only to these large stations. The results obtained from their use are just as satisfactory in the case of smaller stations, but I have referred to the larger ones to-night as being of more interest. I will, however, give the results obtained in one of the smaller types.

THE CLAREMONT ELECTRIC LIGHT PLANT, CLAREMONT, N. H.—This is a small plant operated by both water and steam power. The plant consists of two Edison bipolar dynamos running on the three-wire system, and an arc light service supplied by 50 lights and Thomson-Houston dynamo. In connection with the Edison dynamos, which are operating on the three-wire system, there is a battery plant of 134 cells, containing 11 plates in each cell 10 inches square. These batteries are operated directly in parallel with the Edison dynamos and relieve them of a portion of the load during the time of heaviest amount. They also help out the steam plant, enabling the water power to be used to its fullest advantage.

Take, for example, the following figures for the month of January, 1896. Before the batteries were installed it was found necessary to run an auxiliary engine 180 hours to supplement the water wheel. During the same month in 1898, after the battery was installed, the same conditions as regards water power prevailing, the station load was 33 per cent. heavier and it was only necessary to run the auxiliary steam engine 133 hours during the month.

In addition to this saving, the service given was far superior owing to the steadier pressure, which was maintained. The battery has also enabled them to reduce their staff; the entire force employed in this plant now consists of a superintendent, a dynamo attendant and a lineman. The lineman also attends to the lamp trimming. Before the battery was installed there was in addition an engineer, while the average load was considerably less than at the present time.

There is one application of storage batteries in connection with central stations, which I believe will in time become very general, but which at the present time has only been tried in a few instances. It is the use of storage batteries in office buildings, stores, etc., instead of the usual isolated plant or direct supply from the central station. The method of operation is as follows:

During the few hours of maximum load at the central station, the storage battery supplies the entire current for the building, it being disconnected from the street mains. During the hours of light load the building is connected with the street mains and the battery charged from them. By this means the central station can take as customers these buildings, and only have them on their system during the hours of light load. This is a class of customer which is not profitable for the central station in the ordinary way, as they have a large number of lamps which are only used for a short period, and that at a time when the station has its maximum load. This means that they have to provide capacity for these lamps, and yet the plant is only needed for an hour or two each day. In one installation of this sort, the electric light company say they can charge the battery at a time when they are glad to sell current for 4½ cents a kilowatt hour, and it takes a load of their system at a time when current is worth 13 cents. This leaves a good margin for profit for both user and electric light company. The cost of such a battery plant is less than the isolated plant would be for the same capacity, and occupies very much less space, which in some buildings is an important matter. By this method the central station can also take customers having a fluctuating power load, without feeling its disturbing effect on the system, the battery maintaining an even pressure at all times. This is particularly advantageous when the fluctuating load is some distance from the power house, and the feeders are not large.

The use of storage batteries in connection with isolated plants for private houses is increasing very much. Such a generating plant without a battery requires a lot of attention, as the engine and the dynamo must of course be kept running all the time current is required, and moreover runs under a variable and uneconomical load. With a storage battery, however, current is available at any time and the generating plant need only be run to charge the battery or when an unusually large amount of current is required for special occasions. This class of work is very light on the storage battery, as usually they are only charged two or three times a week, and are only discharged for a short time every day.

The power house of one of such plants is situated about 100 yards from the residence and is 21 feet long by 16 feet wide, divided into two rooms, one for the engine, dynamo and switchboard, and one for the storage battery. The residence is wired for 300 16 c. p. lamps, and the plant consists of a 19½ h. p. Otto gas engine, belted to a shunt wound dynamo of 12½ k. w. capacity, wound for a range of voltage 110 to 150. The storage battery consists of 60 cells, each containing 13 plates 10½ inches square. These elements are mounted in glass jars, and placed in sand trays. Plates hang on the sides of the jars, small lugs being cast on them for this purpose. The capacity of the battery is 60 amperes for 8 hours, 84 amperes for 5 hours, 120 amperes for 3 hours. The switchboard is built in the partition between the battery and engine room, so as to save space, and to allow a free access to the back of the board.

Circuits are so arranged that any combination can be effected, viz., supply lamps while charging the battery, or to charge the battery alone. To supply the lamps from either battery or dynamo direct, or with the two running in parallel.

The plants that we have considered in this paper will give some idea of the numerous methods of applying storage batteries to electrical work. The field for the use of the storage battery is practically unlimited, and comprises every branch of electrical work, and the problems involved are some of the most interesting which electrical engineers have to consider.

The storage battery of to-day is a practical piece of apparatus: the days when it was considered an experiment have passed. Large sums of money are being expended in experiments to reduce the cost of manufacture and lighten the weight, and it is in these directions that the greatest future improvements may be looked for.

Substance Which will Renew Oxygen in Vitiated Air.

A special despatch from Paris of Jan. 28 says: An important discovery was announced in the French Academy of Medicine on Thursday by Georges Jaubert. He has been experimenting on how to supply air or renew oxygen in air for a man in a hermetically inclosed space like a diving bell. The discoverer's hypothesis was that 79 per cent. of the nitrogen contained in respirable air remains intact after 21 per cent. of the oxygen

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has been consumed, and the same nitrogen, mixed with a new supply of oxygen, becomes respirable air when the carbonic acid and the vapor produced by breathing are removed.

Jaubert found that his hypothesis was correct. The most important question was the generation of oxygen. It appears that he discovered a chemical substance, which, by contact with the atmosphere, clears vitiated air of all impure gases produced by respiration and refurnishes automatically the requisite quantity of oxygen. The author states that six or eight pounds of this substance will enable a man to live for twenty-four hours in a diving bell.

The Bovy Electric Furnace.

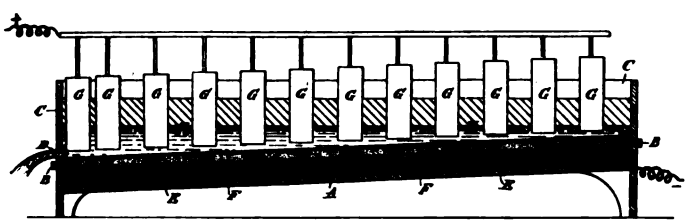
IN most well-known electric furnaces, designed for the treatment of large quantities of material, such as calcium carbid, a large amount of those materials which are to be treated is lost by way of volatilization, and the arrangement of the electrodes is made in such a manner as to have their resistance altered during the proceeding, so that the said well-known furnaces cannot work continuously.

An improved electrical furnace, shown herewith, and recently patented by Hugues Bovy, of Geneva, Switzerland, is constructed in such a manner that the spot where the heat is greatest is so located as to permit the vapors produced by the volatilization of the materials treated to escape only through the materials which have been already melted. Thereby those vapors cause the melted material to be suitably stirred, so that the chemical proceeding is improved by means of a good distribution of the heat within the materials treated.

The furnace may be used either with a continuous electric current or with a monophase alternate current. It may also be used with polyphase alternate currents, but not with so good a result.

The accompanying illustration shows, by way of example, a longitudinal section of one construction of the improved electric furnace.

A is a casing filled with a conglomeration of small particles of carbon and forming the body of the furnace, electrically con-



BOVY ELECTRIC FURNACE.

nected with one pole of the circuit. The body A bears all around it a border of bricks B, which insulate the same from an iron frame C, provided with a melting hole D. The body A bears a series of carbon blocks E, suitably arranged upon its surface and separated from one another by means of a layer of carbon powder *e*, maintained in its place by means of carbon plates F. Above each of the carbon blocks E there is adjustably suspended an electrode G, of carbon, connected to the other pole of the electrical circuit. One carbon block E and its corresponding carbon electrode G are arranged in immediate proximity to the melting hole D, in view of always maintaining the same clear for the constant flowing out of the melted material.

The material to be treated (marked X) is filled up within the frame C and between the electrodes G, as shown in the drawing, and it will be readily understood that when the electrodes G are brought into contact with the electrodes E the latter will be heated to incandescence, and when the electrodes G are lifted and the material X, composing the charge, comes in contact with such incandescent block electrodes the same will be converted into carbid by reason of the heat radiated from the upper ends of said electrodes. The great electrical resistance of the carbon powder *e* will not allow the current to pass from the body A to the electrodes G otherwise than through the block electrodes E, so that the latter become incandescent throughout, and as they only have their upper exposed ends in contact with the material composing the charge they will not be altered in any way as to their electrical resistance, and the whole furnace is enabled to work continuously. Furthermore, the vapors produced by the melting process at the spot where the heat is maximum will be obliged to traverse the whole melted material on their way out of the apparatus. Thereby they will stir up the melted material and greatly improve the chemical proceeding by suitably distributing the heat within the materials treated.

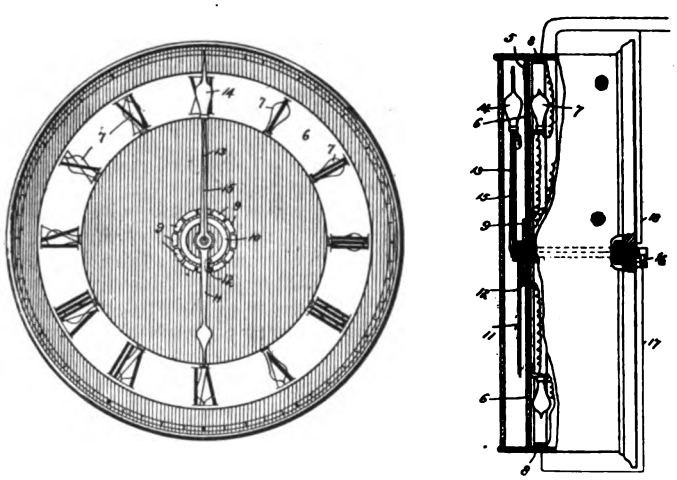
If, on the one hand, the material to be treated is regularly fed into the frame C and, on the other hand, the electric current is continuously sent into the apparatus, the proceeding will be continuous, the melted material flowing out of the hole D. The intensity of the action of the electric current may be regulated at will by means of controlling the distance of the electrodes G from the electrodes E.

An electric furnace of the described system may be constructed without difficulty for using currents of one hundred and fifty thousand amperes and sixty volts—that is to say, for nine thousand kilowatts.

Crane Electrically Illuminated Clock Dial.

A PATENT has recently been granted to Richard T. Crane, Jr., of Chicago, Ill., on an electrically illuminated clock dial, which is as original as it seems practicable and inexpensive. It is specially applicable to clocks used in towers or upon the front of buildings, and embodies means whereby each of the characters on the dial is illuminated in turn, the whole being provided with suitable devices actuated by the mechanism of the timepiece. Referring to Figs. 1 and 2, the clock dial, 5, has index characters arranged on its diaphanous portion, 6. Back of each index character is arranged an electric lamp 7, each connected in circuit between a conductor ring 8 and a segmental contact piece 9, near the centre of the dial. Inside of the circle of segmental contact pieces 9 is arranged a contact ring 10, which is connected by a wire to a dynamo or other suitable source of electricity, the other terminal being connected to the ring 8.

Upon the hour hand 11 is arranged a brush or brushes 12,



FIGS. 1 AND 2.—CRANE'S ELECTRIC CLOCK.

constructed to travel around in contact with the ring 10 and the segmental contact pieces 9, for the purpose of completing the circuit between the ring and each of the contact pieces in turn. By this arrangement, as is clearly obvious, the contact piece, which is connected with the lamp behind the index character over which the hour hand is passing, will be in circuit with the source of electricity and kept lighted during the whole period of time that the hour hand is moving past; but as soon as the hour hand passes a point midway between two index characters the brush 12 snaps over or down upon the next segmental contact piece 9 and throws the next lamp into circuit.

Upon the outer end of the minute hand 13 is arranged a lamp 14, connected by the wires 15, the brush 16, the wire 17, and the wire 18 (which is attached to one of the bearings of the minute-hand spindle) to the source of electricity, the contact being continuous, so that the light upon the minute hand will burn constantly and thus indicate clearly at all times the position in front of the dial.

SEVERAL TELEPHONE BILLS to change and lower, or regulate rates, have been introduced in the New York Legislature.

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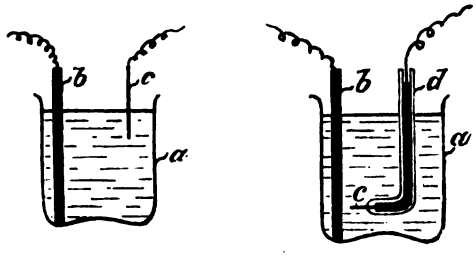
The Wehnelt Electrolytic Current Interrupter for Induction Coils.[1]

BY DR. A. WEHNELT.

IF a current is sent through an electrolyte by means of two electrodes of unequal area and the potential is considerably higher than that of the e. m. f. of polarization, the well known phenomena of light and heat appear on the electrode having the smaller surface. Let us call this electrode the active electrode, after Lagrange and Hoho. This phenomenon has been made the basis of the now well known electric forge, welding and hardening processes. Every one who has studied this phenomenon has observed that it does not consist of a continuous,

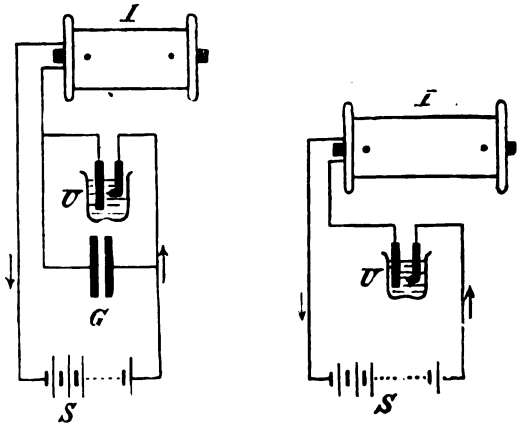


FIGS. 1 AND 2.

but of a rapidly intermittent light, and that it is accompanied by a light humming noise of a more or less high pitch. The intermittent character of the phenomenon was confirmed by Messrs. Koch and Wuellner by means of the telephone. Assuming that the interruption amounted to a total break of the current between zero and its maximum value, it follows that an induction coil inserted in the circuit would act in the same manner as if operated by an interrupter.

The following experiments were carried out with a glass beaker with dilute sulphuric acid, Fig. 1. The electrodes consisted of a lead plate b and of a thin platinum wire c. The heavy squirting which took place on the passage of the current led to the insertion of the platinum wire in a glass tube d, Fig. 2. from which it projected a few millimeters. Mercury poured into the tube served to carry the current to the projecting tip.

The current was furnished by a battery of 60 portable accumu-



FIGS 3 AND 4.

lators. Three different induction coils were used, giving sparks respectively of 3 centimeters, 30 centimeters and 50 centimeters length. Current was also obtained from the Berlin central station. The first experiment was made with the 3-inch spark coil, and instead of the regular platinum break the apparatus shown in Fig. 2 was employed. The arrangement adopted is that shown in Fig. 3. Here I represents the induction coil; G, the condenser; U, the brake; S, the source of current. Upon the gradual increase of the potential a weak, irregular stream of sparks was obtained from the secondary of the induction coil at the moment when the light phenomenon began to manifest itself at the active electrode. The active electrode, which had been made the negative, as in the case of the electric forge process of Lagrange and Hoho, melted off easily. It was therefore tried to use the same as the anode and the result was astonishing.

Even when using very low potentials the instant that the light effect appeared, a steady stream of sparks was obtained, which was converted into a continuous current arc when 80 to 90 volts and about 3 amperes were employed. This light was accompanied by a loud, whistling noise, and the arc could be drawn out to a length of seven centimeters, (about 3 inches).

Encouraged by this result the author was led to undertake the adoption of this kind of break for larger coils of from 30 to 50 centimeters (12 to 20 inches) spark length. The success was the same as with the small induction coil, the results being, of course, correspondingly greater. Even with the employment of six accumulators, that is to say, 12 volts, the phenomenon made its appearance. With six amperes the number of interruptions was already as great as could be obtained by the Deprez interrupter. With increased potential arc flames of from 28 to 46 centimeters length were obtained, which emitted a tone corresponding to 1,000 vibrations per second. With none of the usual brakes, with the exception of the new turbine break of the Allgemeine Electricitäts Gesellschaft, was such an intense stream of sparks obtained.

The following are some of the results achieved thus far:

1. The interruptions of the current by means of the electrolytic break are so sharp that the condenser is entirely superfluous in connection with the induction coil. The best way is to connect the primary coil and the interrupter in series as

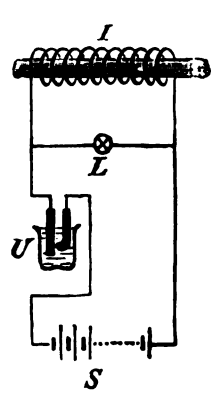


FIG. 5.

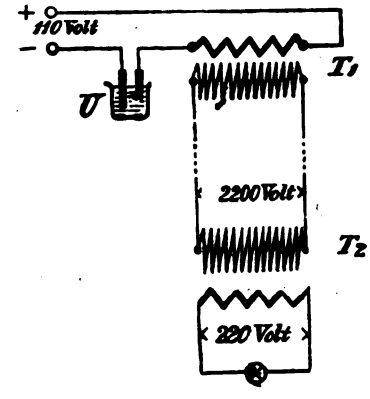


FIG. 6.

shown in Fig. 4. Self-induction heretofore carefully avoided or sought to be suppressed as much as possible, is not only entirely innocuous in connection with this new break, but, on the contrary, actually favors the formation of the light effects and hence the sharpness of the breaks. Without self-induction in the circuit the potential required for this phenomenon is in general higher.

2. The number of interruptions or speed of the break increases with increased potential. The lowest potential at which the phenomenon occurs depends entirely upon the conditions chosen (electrolyte and electrodes, resistance and self-induction in circuit). When employing the apparatus described in Fig. 2 and a 30 centimeter spark coil, the phenomenon occurred with six accumulators, that is, with twelve volts. The most advantageous electrolyte has been shown to be that consisting of dilute sulphuric acid of from 20 degrees to 25 degrees Baumé. The metal of the cathode is immaterial; for the anode (active electrode) platinum has thus far been shown to be the best.

The number of breaks obtainable by this method has been measured and reaches from 200 up to 1,700 per second.

3. The current strength increases with the area of the active electrode. With the apparatus here employed, a series of measurements with various sized electrodes always showed a current density of 0.41 ampere per square millimeter area. The regulation of the current density can, therefore, be very well effected by changing the area of the active electrode and thus avoiding the use of external resistances. Of course, with increase in the current strength the number of breaks per second decreases

[1]Elektrotechnische Zeitschrift, Jan. 26, 1899.

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since the apparent resistance of the induction coil is increased.

4. An incandescent lamp shunted across the primary induction coil, as shown at L, Fig. 5, glows brightly. Thus in one case where the battery e. m. f. was only 21 volts, the e. m. f. at the terminals of the primary was 58.5 volts. This great increase in potential at the terminals of the coil reminds one forcibly of the effects obtained by means of the vacuum break and they are therefore a full proof of the completeness of the interruptions.

The high rate as well as the uniformity of the breaks, the entire absence of all wearing parts, as well as the availability of taking current directly from existing 100 to 110-volt circuits make the electrolytic interrupter specially available for use in connection with spark coils, for induction coils with Tesla experiments, for the Marconi spark telegraphy, for the production of Hertzian waves, and even for those experiments which are usually performed with alternating current.

A 50 centimeter spark coil had its spark length increased to 93 centimeters, while a 30 centimeter coil gave a 57 centimeters spark. The discharges are in the shape of brilliant arcs accompanied by a strong aureole.

For X-ray work particularly, the interrupter has been shown

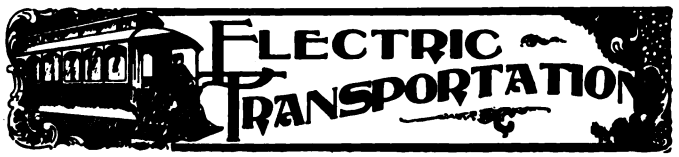
FIG. 7.—WEHNELT ELECTROLYTIC CURRENT INTERRUPTER.

to be of great value. All flickering in the fluorescent screen is avoided with the proper arrangement of the apparatus. The time of exposure for photographic X-ray work is greatly reduced owing to the high rate of interruption. Effects which formerly required large coils are now produced by small ones. Thus, for example, a 2 centimeter (⅞ inch) spark coil with a large Röntgen ray tube designed for 12 to 15 centimeter sparks admits of the X-raying of the extremities of adults. A 15 centimeter spark coil, used in connection with an X-ray tube designed for a 30 centimeter coil, gave excellent penetrations of the chest and the pelvis. For large induction coils the tubes would have to be constructed in a more substantial manner since the anti-cathodes are heated very rapidly to the point of fusion.

In using the apparatus in alternating current experiments the following experiment was made: The brake U was inserted in series with the primary of a transformer T_1 across a 110-volt circuit, Fig. 6. The transformer ratio was one to ten. The potential on the secondary was not 1,100 volts as might have been expected, but 2,200 volts. This potential was transformed in a second transformer T_2 down to 220 volts, the two transformers being both alike. The same phenomenon is observed here as in the case of the primary of the induction coil. This apparatus is constructed by the firm of Ferdinand Erneck, of Berlin, and is illustrated complete in Fig. 7.

Railway Work at Alton, Ill.

The Alton Railway and Illuminating Co. is adding one mile to its system in Upper Alton and five miles to East Alton, adding also five cars. It is purchasing generators, motors, cars, track, overhead supplies, etc. The present road was equipped by the General Electric Co., and has 9½ miles of 60 to 70-pound T-rail track, with ten cars. It has about 150 miles of circuit for railway, power and lighting. It has 1,250 h. p. of Buckeye engines. Mr. J. F. Porter is president.



The Guest System of Sealed Conduit Electric Railway.

MR. J. H. GUEST, of New York City, well known as an inventor in other electrical fields, has recently worked out a very very simple and ingenious system of sealed conduits for electric street railways.

High resistance magnet coils and ground connections for initially energizing switch magnets are entirely dispensed with by Mr. Guest as well as the necessity for using a second line of buttons or contacts as required in the perfected button system. One magnet carried by the car furnishes a moving magnetic field for initially energizing in succession all the switches in the conduit, which is completely sealed up. This magnet takes the place of all the high resistance ground or shunt coils heretofore used in the line of boxes of the button system. After initial contact is established by the action of the moving magnet, solid contact is established and maintained by one or two turns of wire in the circuit of the switch surrounding one of the induction plugs which latter also constitute interior supports for the working parts of the switches. The induction plugs operate upon the pendulous armature of the switch and the turns of wire surrounding one of them reinforce the action to bring the contacts of the switch firmly together. The surface contact is a rolled iron rail flush with the street surface and is "dead" until covered by the car. The conduit itself is ordinary channel iron of usual depth, and the contact rail constitutes the cover therefor and is bolted down upon it water tight. All working parts of the switches are supported by the cover plate, and it is only necessary to detach a section of the latter in order to remove the switch for repair or replacement.

In the accompanying diagram, the system is shown by Figs. 1, 2 and 3 in cross and longitudinal vertical sections. A is the channel iron conduit laid as a continuous conduit upon a longitudinal stringer B, or other support. Drainage pits might be provided at intervals, but are not necessary. C is the rolled iron cover plate flush with the surface of the roadway, and D is the street surface asphalt packing, surrounding and partially insulating the conduit. The cover C is bolted down water tight upon the conduit A by bolts E, of turn-buckle pattern, as indicated, and is arranged in sections insulated from one another and of the desired length according to the length of the car in use. A water tight packing serves also as an insulation interposed between the cover plate and the body of channel iron portion of the conduit. F indicates iron plugs secured in the cover plate at intervals of, say, eighteen inches and magnetically insulated therefrom by a non-magnetic bushing F. These plugs operate as induction plugs to convey the magnetism from the magnet G into the conduit. The magnet is carried by the car truck with its pole close to the surface of the cover and is energized either by the working current or by a battery on the car, or by the two working in conjunction. Within the conduit the plugs act inductively upon armatures H of any desired length, one armature being provided for any number of plugs. The armatures have a pendulous suspension from the plugs by means of hangers h suspended at i on the plugs. The suspension may be a pivotal suspension or by preference flexible hangers formed of compacted bundles of woven copper wire, gauze h are used. These hangers may be soldered or bolted to the armature and to the plug. The armatures may be furnished with contact shoes of copper or carbon to close circuit upon a number of flexible contacts k, k, supported from every third plug, as shown, or at greater or less intervals and which are connected to the insulated feeder or main L, lying within the conduit. The armature may also be made to close the circuit directly upon all of the plugs which act upon it. The armatures are electrically connected with the plugs and, therefore, with the cover plate, while the bar carrying the contacts k, k, is insulated from its supporting plug and one or more turns of the connecting wire between said bar and the feeder or main L are carried around the plug which thereby becomes strongly energized as soon as contact is made, thus insuring a firm and solid engagement of the contacts as soon as the circuit is made, and

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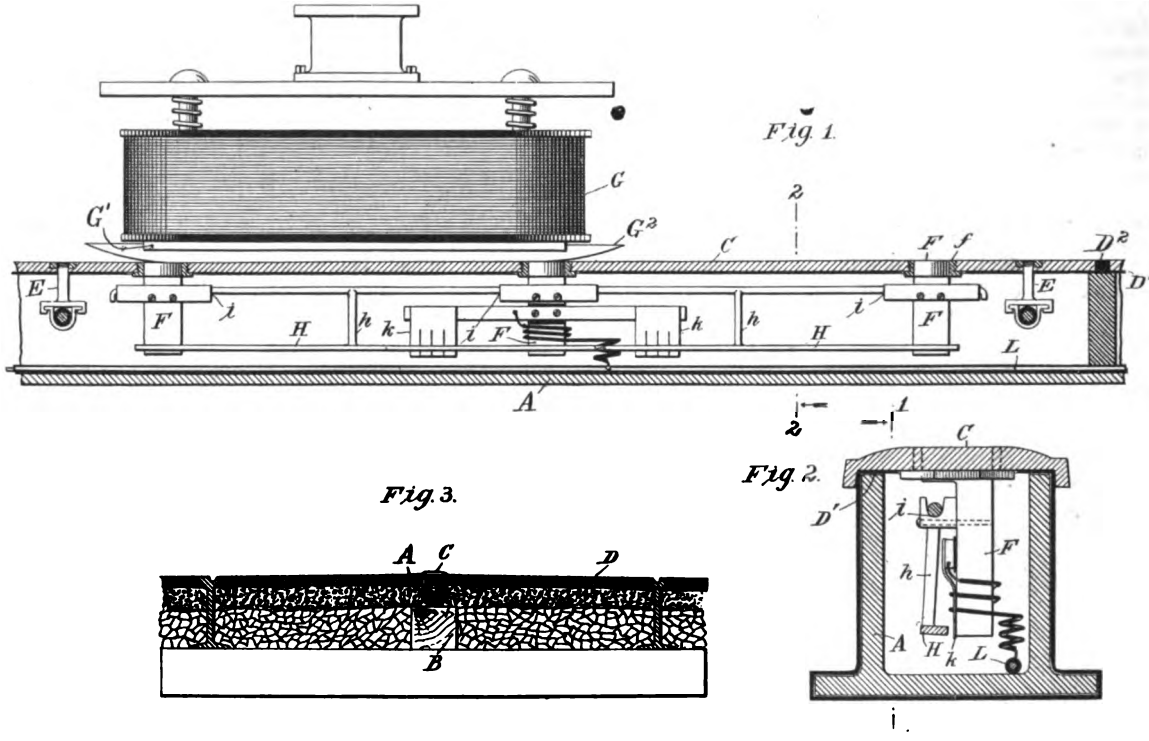
so long as power is being taken from a section of the surface rail from which the contacts are hung.

The current is picked up from the surface rail or cover by any sort of collecting device carried by the car truck and riding on said cover. When a car leaves a section, the armatures for that section swing back by gravity and the section of cover by which they are supported becomes dead until another car with its magnet passes over it.

A conduit four inches in depth and three inches in width over all is ample for containing all the working parts, and an even less depth of channel iron may be used.

The simplicity of this device is obvious. All the parts being supported from the cover, it is only necessary to open the latter back on one edge to allow inspection or to simply replace it by a dummy section over which the cars will drift during repairs.



FIGS. 1, 2 AND 3.—THE GUEST CLOSED CONDUIT TROLLEY SYSTEM.

Conservative estimates by competent experts, who have examined the full sized working section now on exhibition at Temple Court, 119 Nassau street, Room 1036, New York City, indicate, we are told, that the system can be built and laid at a cost which is insignificant as compared with that of the slotted conduit system now in general use or of the various substitutes therefor, which have been brought to public attention.

Automobile Tires.

Discussing the subject of tires for automobiles, in the "India Rubber World," Mr. G. H. Condict, of the New York Electric Vehicle Co., says: "One essential is easy riding. The only tire material that will assure this is India rubber. Having started with pneumatic tires, we find that our public will be satisfied with no other. We have tried solid tires, but the public object to these after having tried the pneumatics. We have also tried cushion tires, but these lack resiliency. Under vehicles weighing 3,200 pounds and upwards, cushion tires, unless inflated, become flattened and give the same result as solid tires. Hence we have experimented with every pneumatic tire that has been brought to our notice, but they all puncture too freely. We have tires in use that have run probably for six months, but in some instances tires have had to be sent to the repairer on the first day. We are in a position to welcome suggestions from every man, in the rubber trade or out of it, who can suggest a better construction of tires than we have yet secured. To-day we have fifteen different tires in use, but are still experimenting."

Mr. H. Souther, consulting engineer on tests for the Pope Manufacturing Co., says: "Probably the next important factor, in the development of the automobile, is the road that you carry with you on the rim of the wheel—the India rubber tire in some form or other. That made the bicycle popular, and will make the carriage so, to a lesser degree. In the first place, a good tire renders a lighter construction possible, all other things being equal, because of the lessening of shocks. Then, too, it does away with the noise so noticeable in the horse propelled carriage, and so much more annoying in the heavier, and naturally more noisy automobile."

Mr. C. E. Corrigan, of the American Electric Vehicle Co., says: "Our preference is decidedly in favor of solid rubber tires, which contain a larger amount of rubber than the pneumatic tires."

The "India Rubber World" says that a well known engineer has expressed to it his belief that for passenger vehicles, pneumatic tires, or cushion tires, will be used at 100 pounds air pressure; and that for heavy vehicles, flat rubber band tires will be used.

Auto-Motor Wagons.

The Auto-Truck Company of New York is arranging, it is stated, a contract to equip the police stations of the city with auto-motor patrol wagons. The Gerry society has already closed a contract with the company for one auto-motor patrol wagon for carrying children from the society's rooms in East Twenty-third street to the various courts.

The price of the wagon was not disclosed. The cost of the patrol wagon for horses is $800, and the expenses for a driver and care of the horses has been $125 a month.

Underground Is Popular In Boston.

Following the unofficial figures published a week or two ago, the Boston Transit Commission presents a set of figures relating to street car traffic which show that the present car movement, south bound, from Park street, between the hours of 5 and 6 at night, is greater by 45.5 per cent. than it was for a corresponding time in 1895, while the increase in the number of passengers handled is about 133 per cent.

This remarkable increase is far beyond what the Subway Commissioners believed it would be when the underground system was first exploited. It was generally accepted at the time that part of the traffic naturally belonging to the subway would be diverted to the all-surface lines, because of the aversion many would have to going through the tunnel. The facts show that this assumption was valueless.

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Successful Operation of the Sprague Multiple Unit System on the Chicago South Side Elevated.

IF there be anyone who in the past has entertained the slightest doubts as to the availability of electricity as a motive power for elevated roads or has looked upon its introduction as an unwise financial investment, he will have his doubts dispelled and probably his views reversed after reading the annual report of President Carter, of the South Side Elevated Railroad, Chicago. It is, as was expected by the advocates of the economic features of the Sprague multiple unit system, a most forcible argument in favor of electricity as a motive power and one so strengthened and fortified by indisputable figures representing gains and savings on every hand that it will serve without further defence or modification as a reply to all who have endeavored to belittle electricity or doubt its efficacy.

"It appears," says Pres. Carter in his report, "that the cost of operation has steadily decreased, month by month, partly because better results have been, as is usual, obtained from the power house after a few months' use.

"The cost of operation for the entire year was 69.3 per cent. This includes the loop rental of ½ cent a passenger and our share of the cost of operating the loop.

"Not including the loop rental, the cost of operation was 60 per cent. During the months of January, February and March, when we operated entirely by steam, the cost of operation was over 80 per cent. During the months of October, November, and December, when we operated entirely by electricity, the cost of operation was 57 per cent., including the loop rental, and all expenses except the interest charge. Not including loop rental, but including all other loop expenses, and every expense which can be called operating charges, including taxes and car licenses, the road was operated in October for 47 per cent., in November for 47.7 per cent., and in December for 45.4 per cent. While expenses have been decreasing, we have the satisfaction of reporting that the gross earnings have been steadily increasing.

The first year of operation on the Union loop ended on Oct. 18, 1898, and showed an increase in passengers of 51 per cent. The first quarter of the second year on the loop, which ended on 18, 1899, showed an increase for the three months over the corresponding three months of a year ago of 13 2-5 per cent.

"The record, therefore, indicates, by reason of the declining percentages of operating expenses, that with the same traffic during the year 1899, the road should show more net than it did last year, while the steady increase of traffic encourages us to believe that the net will be still further increased by reason of the larger revenues.

"The net earnings of the last six months of 1898, being the first six months of electrical operation, show a net earning of $196,933.26. By deducting six months' interest charge, or $16,875, there will remain $180,058.26, applicable to dividends, or at the rate of 3½ per cent. per annum on the capital stock.

"The earnings for 1897 were at the rate of a little more than 1 per cent. on the capital stock; for the first half of 1898 at the rate of 1⅞ per cent.; and as stated, for the last half of 1898, at the rate of 3½ per cent. on the capital stock.

"It has seemed best to your directors to expend the sums so earned on improving the earning capacity of the road, and meeting the demands of the public for increased facilities for travel without increasing your indebtedness by the issue of bonds.

"At the time the change in power was undertaken, the road needed about 90 cars to transact its business, and 120 cars seemed as many as it was prudent to provide for, but with our growing patronage it has become necessary to make the entire equipment of 180 cars available, and accordingly, the remaining 60 cars have been equipped, 30 as motor cars, and 30 as trail cars.

"Power was turned on in the power house April 21, the plant then being uncompleted. It was fully completed for reliable service in July. It has been in constant operation and has never failed to respond to any demands for power required in the operation of the road since that time. The cost did not exceed the original estimate, and the building is nearly 50 per cent. larger than originally estimated upon. The cost of operating the plant does not exceed the estimate, although the yearly output is at the rate of 11,000,000 k. w. h., instead of 9,000,000 k. w. h., as originally estimated. Daily service has demonstrated that the plant is properly proportioned, so that all parts respond in unison to demands for maximum capacity. The operating expenses of the plant, based on maximum power required of 8,000 horse power for about four hours each day in the winter months, is about $8 per horse power per annum. Adding to the above, general expenses, 10 per cent. depreciation, interest, insurance, and taxes, the total cost per maximum horse power per annum does not exceed $15. Estimates for installing more generating capacity to meet the growing demands of the traffic are prepared, and your directors have decided to increase the power nearly 50 per cent. for use next winter.

"At the time of the last annual meeting we reported that the test of the train equipped by Mr. Sprague, made on the Metropolitan Elevated Road, was satisfactory. We began using electric cars in April, had 67 in operation in May, and gradually increased the number until July, when they finally superseded the steam trains. We had minor difficulties to contend with which were met and solved. None of them resulted in injury to any passenger, and none of them involving the control of the train, which has always been complete. I am assured that the difficulties and annoyances were not so great as they were in installin the excellent steam locomotives which they displaced. We believe that the Sprague multiple unit system has fulfilled expectations. Exhaustive tests have proved the economy of rapid acceleration and long coasting. A schedule speed of fifteen miles per hour is easily maintained, and time lost is easily made up. If needed in order to meet competition, your company has the ability to increase the speed to twenty miles miles an hour.

"The reliability of the equipment has been fully tested this winter, when 150 cars, all we had, were in daily operation (Sundays excepted) for many weeks.

"We have not been in electrical operation long enough to definitely determine the cost of maintenance, but we have sufficient data to confidently state that it will be low, as low as any other line doing equivalent service, and lower than many surface lines with 18-foot truck cars. The advantage of this flexible system on crowded days, for switching and changing the length of trains is apparent."

Of the storage batteries, President Carter said that he knows them to keep up the voltage at the ends of the line, enable the

TRAFFIC, EARNINGS, AND EXPENSES, JAN. 1 TO DEC. 31, 1898.

	Traffic.		P. C. of inc. over	Earnings.		Expenses.		Net	P. C. of exp. to
Month—	Total.	Daily av.	1897.	Total.	Daily av.	Total.	Daily av.	earnings.	e'rings.
January	1,615,626	52,117	.48	$82,927.22	$2,675.07	$70,242.55	$2,265.89	$12,684.67	84.7
February	1,475,351	52,691	.47	76,119.32	2,718.55	63,597.85	2,271.35	12,521.47	83.5
March	1,699,663	54,828	.54	87,631.33	2,826.82	71,101.20	2,293.59	16,530.13	81.1
April	1,624,476	54,149	.56	84,391.38	2,813.04	68,170.47	2,272.35	16,220.91	80.8
May	1,533,238	49,459	.51	79,925.78	2,578.25	56,101.25	1,809.72	23,824.53	70.2
June	1,362,821	45,427	.54	70,633.88	2,354.46	53,442.91	1,781.43	17,190.97	75.7
July	1,368,581	44,148	.63	70,662.98	2,279.45	49,762.77	1,605.25	20,900.21	70.4
August	1,294,864	41,770	.54	67,733.75	2,184.96	43,175.69	1,392.76	24,558.06	63.7
September	1,397,286	46,576	.55	72,336.36	2,411.21	45,681.43	1,522.71	26,654.93	63.2
October	1,804,124	58,198	.48	92,618.58	2,987.70	52,602.76	1,696.86	40,015.82	56.8
November	1,777,717	59,257	.09	92,372.14	3,079.07	52,923.58	1,764.12	39,448.56	57.3
December	1,944,791	62,735	.10	100,938.78	3,256.09	55,583.10	1,793.00	45,355.68	55.0
Total	18,898,538	51,777	.42	$978,291.50	$2,680.25	$682,385.56	$1,869.55	$295,905.94	69.8

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road to operate more cars, furnish increased facilities to patrons and prevent damage to power house machinery in case of sudden demand for increased power.

He referred briefly to the company's litigation during the year and gave out a remarkable financial statement.

"Remembering what is said about the introduction of electricity and reduction of operating expenses, the following statement becomes quite interesting:

A special feature worthy of note in the matter of traffic is the gains of November and December over the corresponding months in 1897. In those two periods conditions were practically the same—that is, the full use of the Union loop had been enjoyed. The increase, therefore, of 9 per cent. in the traffic for November over the corresponding month in 1897, and the increase of 10 per cent. for December over the corresponding months in 1897, apparently indicate the rate of annual improvement which may be fairly expected so long as business conditions remain as they are. The 10 per cent. growth, too, should be very satisfactory to the shareholders.

Termination of an Important Electric Railway Patent Suit.—Siemens Pioneer Work Not Controling.

WITHIN the last few days a bill in equity has been dismissed by which the Siemens & Halske Electric Company of America sued the Metropolitan West Side Elevated Railroad Company of Chicago, et al., for infringement of U. S. Patent No. 324,176, issued to Dr. Ernst Werner Siemens, of Berlin, Germany, August 11, 1885, on his application filed December 9, 1884 (Serial No. 149,896), for improvements in electric railways. Of the twenty-two claims of this patent, testimony has been taken alleging the infringement of six, namely, Nos. 15, 16, 18, 20, 21 and 22. Of these the three following are the most important:

"15. The combination, substantially as herein described, of an electro-dynamic motor suspended beneath the bottom of a car, a series of resistances arranged beneath the floor of a car, and a circuit-controlling lever or switch capable of including or excluding the resistances in or from the circuit.

"18. The combination, substantially as herein set forth, of conducting-rails mounted on the side of the track, contact-springs fastened to the side of the car, an electro-dynamic motor and its commutator, a conducting connection between said springs and motor, and a lever capable of breaking or closing the circuit between the springs and motor.

"22. In an electric railway the combination of a wheeled vehicle having an electro-dynamic motor mounted thereon, which is included in a circuit of conductors from a stationary dynamo-electric machine, a circuit-controlling device placed upon said vehicle, and a series of resistances, as and for the purposes described."

An examination of these three claims shows that Claim 15 purports to cover all electric railway vehicles wherein the motor is suspended beneath the bottom of the car and the rheostat is arranged underneath its floor; that Claim 18 undertakes to cover a combination in which a side third rail and contact springs are used; and that Claim 22 goes to cover broadly all existing electric railways in which a stationary source of electrical energy is employed, and the flow of the current through the motor is controlled and regulated by a rheostat on the vehicle.

Naturally the defendants have devoted a large portion of their attention to an effort to prove that this broad combination of Claim 22 was too old in the art to have been first invented by Dr. Siemens, while they agreed that this combination was actually used by him in his first electric railway, at Berlin, in May, 1879. The testimony of defendants' witnesses brought out the fact that the stationary source was clearly pointed out by the British patent to Pinkus, No. 8644 of 1840, while an operative form of motor for propulsive purposes had been used by Jacobi in his Neva boat experiments in 1838. Another form had been used by Davidson in his Edinburgh and Glasgow experiments of 1839, and still another had been described by Taylor in his British patent No. 8,255 of 1839. Pinkus had also described an electric locomotive moving upon rails with a metallic circuit formed of two conductors placed between the traffic rails and a double contact device carried by the vehicle.

An article in the "Mechanics' Magazine" of 1845, Vol. 43, page 426, had suggested the idea of conduction of current from the stationary source to the moving car, and return, by the traffic rails, and this had been embodied in the working model of Dr. Gardner C. Colton in 1847, shown again at the New York Electrical Exhibition of 1896. A circuit controller and rheostat on the car had been described by Hjorth in his British patent No. 12,295 of 1848, and a self-exciting (mutual accumulation) dynamo-electric machine in his British patent No. 806 of 1855. In a French patent issued to Aymonnet in 1875, No. 108,381, the control of a railway motor by a rheostat had been still further elucidated, and it was known to the art that if these forms were not satisfactory, such a rheostat was available for this purpose as Wheatstone had described and illustrated in his British patent No. 9,022 of 1841.

It would appear that in February, 1878, Chretien secured his French patent, No. 122,593, and illustrated both manual and automatic means of actuating his rheostat for the government of a stationary electro-motor; and when in December, 1878, he described in French patent No. 128,075, the application of such a rheostat to the regulation of a railway motor; and when in the fall of 1878 and the following winter, Chretien and Felix actually operated an electric elevator at Sermaize by a motor so controlled, and followed this by their famous plowing demonstration of May 22, 1879, when, propelled by two rheostatically-controlled motors, heavy vehicles for drawing the plows, they really accomplished very little which had not been accurately foreshadowed by prior patents. Their plowing apparatus embodied, however, all the essential features of Claim 22 of the Siemens patent in question, with the exception of the railway track upon which their vehicles might have been propelled as well as along the border of a plowed field.

It has also been fully brought out in this suit that Mr. Edison had every feature or element of the combination of Claim 22 in his Menlo Park electric railway of May, 1880, and that he used this combination of apparatus for the purpose of constructing the greater portion of his roadbed, carrying the ties, gravel and rails, and (after the road was completed) a large number of passengers.

This use of the rheostatically controlled railway locomotive actuated from a stationary source was repeated by him in his Menlo Park road of 1882, which was about three miles in length and was likewise constructed by the electrical equipment and carried passengers at 30 to 40 miles an hour. Thus Edison's two railways each afforded a public use of the combination of Claim 22, more than two years prior to the date of application for the Siemens patent. That so many features were embodied in the Edison work is a surprise to many well informed people.

Several of the questions which have been of great interest in this suit were considered by Judge Townsend in his opinion in what is popularly known as the "Field Case" (Electric Railway Co. of the United States vs. The Jamaica & Brooklyn Road Co. on patent No. 407,188), which opinion was rendered in 1894. A short quotation will suffice to illustrate how closely the rival claimants for railway pioneer honors approached each other in the time and essence of their work: "It is a significant fact, upon the questions of pioneership and success, that Boué and Chretien, in 1878, Field and Siemens in 1879, and Edison in 1880, all described or constructed electric railways upon principles substantially the same, and that these principles did not materially differ from those described by earlier inventors and well known in the art, except in the substitution of the new and more efficient types of generators, and that such measure of success as these alleged inventors achieved was confessedly chiefly due to the increasing efficiency of said generators. Assuming the utility of said approved appliances, it may be questioned whether, so far as the elements of invention are concerned, they show anything more than such an application of these new generators to new purposes as would have occurred to any person skilled in the art, as it did occur apparently almost simultaneously to the said five persons. That it marked an advance in the art, of incalculable value, cannot be denied, but it is at least a question whether the chief credit for such advance should not be given to the inventor of the generators whereby these results became possible, rather than to those who adapted these

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new generators to new but analogous uses. Given the perfected Gramme generator, and the prior art, and the successful electric railway is the necessary result."

Following out the idea contained in the latter part of Judge Townsend's statement above quoted, appropriate efforts were made in the suit just dismissed, to express upon the record the proposition that Siemens invented and developed what he has in some of his writings and depositions called "The dynamo-electric principle," and hence, the modern dynamo-electric generator. This effort led to an analysis by the defendant's witnesses of the so-called "Dynamo-electric principle" into three components, as follows:

"1. The whole or a part of the current generated by a dynamo electric machine may be relied upon to serve as the electrical starting point of a practically useful magnetic field, which is developed and maintained by a mutually cumulative effect of armature current and electro-magnetism of the field and armature.

"2. The initial magnetism of the field which is necessary to start this mutually cumulative action may be applied to the armature coils by the permanent magnetic strength (relatively large) which persists in a steel magnet after being once charged from an outside source.

"3. This initial magnetism may also be applied by the permanent magnetic strength (relatively small) which persists in a soft iron magnet after being once charged from an outside source, and which is known to the art by the term "residual magnetism."

It was then shown that Dr. Siemens did not, in these senses, originate or discover the broad principle of mutual accumulation as stated in the above first enumerated paragraph, nor did he discover the sufficiency of steel magnets, as stated in the second enumerated paragraph; but that as early as 1848 Jacob Brett disclosed these ideas in his British patent No. 12,054, and that he was followed up by Sinstenden in 1851, Hjorth in 1855, Johnson in 1858, Farmer and Baker in 1866. It also appeared that if Dr. Siemens made any discovery it was the one expressed in the third enumerated paragraph of the analysis, and that the independent honor of that discovery is now known to belong also to Sir Charles Wheatstone, who embodied it in an operative experimental machine as early as July, 1866 (four months before Dr. Siemens' alleged date of discovery), and that Wheatstone's apparatus illustrated not only the series field magnet winding which Siemens described, but shunt winding as well. It was also brought out that Siemens did not construct an electric railway until the shuttle-wound or H type of armature which he had constructed and illustrated in his British patent No. 2,107 of 1856, and which still survives in the form of magneto telephone bells and similar small apparatus, had been adapted for railway purposes by the embodiment of the principles worked out by Pacinotti, Gramme and Van Hefner-Alteneck, and that even with that assistance the Siemens dynamos of 1879 were inferior in size and efficiency to those of Gramme. It also appeared, strangely enough, that it still remained for Edison to adapt the drum armature dynamo to modern comprehensive railway work by greatly reducing the resistance of its armature coils and thereby increasing its commercial efficiency for multiple arc systems; and by proportioning its field magnets so that they became massive in comparison with its armature core, and produced an intense field while yet they were well below saturation, and therefore regulatable by manual or automatic variations of their exciting currents.

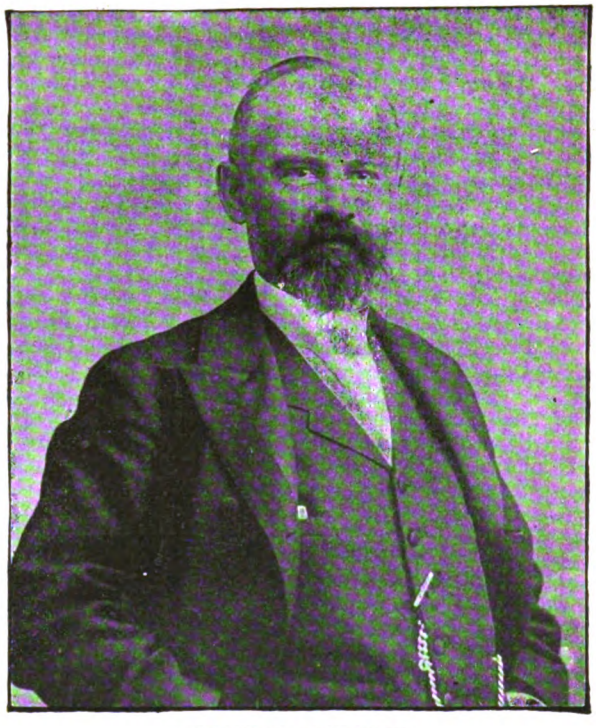
These anticipating patents and publications in Europe, and these prior public uses in America have apparently satisfied the Siemens & Halske Co. of America of the futility of further pressing their suit in this particular case. It seems but a few years since the famous interference proceedings in the U. S. Patent Office between Siemens, Edison, Green, Field and Hall, in which each of these early claimants endeavored to show his priority in the broad combinations of electric railway apparatus, and it is noteworthy that all of them have now disappeared from the field of patent litigation of these fundamental claims, with the exception of Green, who, through the present owners of his patents, is now before the United States Circuit Court of Appeals. The earlier, like the later, electric railway art, was very much in the way of an evolution, and not the inventive property of any one man, however great his ability or merited his distinction in this field.

MR. F. K. BOOMHOWER of Chateaugay, N. Y., has been appointed assistant electrical engineer at the Auburn State Prison.

Jesse H. Bunnell.

JESSE H. BUNNELL, of the firm of J. H. Bunnell & Company, of Manhattan, manufacturers of electrical supplies, and for a number of years a resident of Brooklyn, died on Feb. 8 in that city, of heart failure. He had been ill but a few days, and his illness, at first the grip, was not till the last night thought to be serious. Mr. Bunnell was 57 years old, and leaves a widow and four children, two sons and two daughters. The funeral took place on Feb. 10, at St. John's Episcopal Church, Brooklyn.

Mr. Bunnell was born in Massillon, O., in 1843. In 1854 he entered the telegraph office in Massillon as a messenger, and there learned to operate. From 1859 until 1861 he was successively operator at Columbus, O.; Crestline, O.; Wheeling, W. Va.; Sandusky, O., and Pittsburg, Pa. From April, 1861, to August, 1864, he was with the Army of the Potomac at the headquarters of McClellan and Burnside, and with the Army of the Cumberland, with Rosecrans, Thomas and Sherman. After enduring many hardships of the camp and the field, he succumbed at Atlanta, just as Sherman was preparing for his march to the sea, and returned to his home.



JESSE H. BUNNELL.

His first service was at the end of June, 1861, when he was stationed at Annapolis, Md., as one of the operators in the chain that connected Washington with the North. The defeat of the Federals at Big Bethel, on June 10, was followed by the withdrawal of the Confederates to Yorktown. The Federals seized upon the withdrawal as affording an opportunity to open communications with Fort Monroe and Newport News, and Bunnell was sent to Hampton, Va. In the Peninsular campaign Bunnell was attached to McClellan's headquarters as McClellan's personal telegrapher at headquarters on the steamer "Commodore," at Yorktown, and he then operated a wire from the steamer to Washington. As McClelland's operator, Bunnell went all through the campaign and was with his commanding officer on the field at Antietam, where he set up his office and sent and received messages under fire.

In 1863 the Department of the Cumberland sent a call in for good men for the military telegraph service in the field, and Mr. Bunnell, having already established a reputation for daring, coolness and judgment, was sent along with a number of others,

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to Rosecrans' headquarters. With the Army of Cumberland at Chattanooga and Missionary Ridge, Bunnell saw some terrific telegraphing experiences, and he afterwards endured the discomforts of the starvation winter at Chattanooga in 1864.

From Chattanooga to Atlanta Bunnell and his fellow operators followed the army, setting up their offices daily, and moving when the headquarters moved. At Atlanta, overcome by exposure, Bunnell, as noted above, was obliged to quit.

While in the active service Mr. Bunnell was known as one of the lightning senders of the country. In 1860, before the war, while still a young operator, on the occasion of President Buchanan's last message to Congress, he made a two-hour record of an average of thirty-eight words a minute. Mr. Bunnell was in Pittsburg, and the receiver was L. C. Weir, in Cincinnati, who took eight manifold copies for the whole time without a break. That was one of the wonderful achievements of the times.

After the war Mr. Bunnell was for a time a member of the firm of Partrick, Bunnell & Co. Later he came to New York and for a short time was associated with L. G. Tillotson & Co., on Dey street. About twenty years ago he became associated with Mr. Charles McLaughlin, as J. H. Bunnell & Co., at 76 Cortlandt street, and the firm has continued ever since. Mr. Bunnell was a member of The Old Timers Telegraph Association, the U. S. Military Telegraph Corps and many other organizations. We are indebted to the "Telegraph Age" for an excellent portrait herewith.

The pall bearers at Mr. Bunnell's funeral represented the commercial, and railroad telegraphs, the U. S. Military Telegraph Corps, the press and the electrical trade as follows: Postal Telegraph Co., A. B. Chandler, president, Mr. F. W. Jones, electrical engineer; Western Union Telegraph Co., Mr. Chas. Tinker, general superintendent, Mr. Jas. Merrihew, general superintendent; U. S. Military Tel. Corps, Col. Jas. Gilmore, Mr. J. W. Dealy; Railway Telegraphs, Mr. Robt. Stewart, superintendent telegraph C. R. R. of N. J.; The Electrical Press, Mr. Chas. E. Price, "Electrical Review"; The Electrical Trade, Mr. Chas. McLaughlin, surviving partner of the firm of J. H. Bunnell & Co. A majority of the pall bearers were also members of the Old Time Telegraphers' Association.

As a response to many inquiries, we are authorized to state that the business will be continued as before, at the same place, under the title of J. H. Bunnell & Co.

Hugh L. Childress.

Hugh L. Childress, superintendent of the Southern Division of the Postal Telegraph Company, with headquarters at Birmingham, Ala., died at Chattanooga, Tenn., on Feb. 4, after a long illness, of meningitis. Mr. Childress was formerly manager for the Postal Telegraph Company, at Cleveland, Ohio.

American Street Railway Association.

The eighteenth annual meeting of the American Street Railway Association and third annual meeting of the Street Railway Accountants' Association of America will be held in Chicago, October 17, 18, 19 and 20, 1899, at "Tattersall's," State and Sixteenth streets.

President Charles S. Sergeant, Secretary and Treasurer T. C. Penington, Walton H. Holmes of Kansas City, Albion E. Lang of Toledo, George A. Yuille of Chicago, Frank G. Jones of Memphis, John I Beggs of Milwaukee, and Ira A. McCormack of New York, members of the Executive Committee of the American Street Railway Association, met in Chicago on the 6th and 7th instant, and completed all the preliminary arrangements for the convention. The hall is well suited to the purpose of the exhibits having a clear floor space, without columns, of 50,000 square feet. The meeting rooms of both Associations will be under the same roof, with ample retiring and committee rooms. The last day of the convention will be set apart for the systematic and careful inspection of the exhibits by the delegates, a fact which will be appreciated by all exhibitors. The banquet will be given on the night of the last day, at which the installation of the newly-elected officers will take place. The committee resolved to make unusual efforts to secure the attendance of representatives of the mechanical, operating and auditing departments, which will make the convention of great practical value to these departments; the attendance of delegates having been largely confined to the administrative departments.

The hall will be well heated and lighted; the light during the hours of the day leaving nothing to be desired. All the exhibits will be on the same floor, and there will be little choice as to location. All electric power necessary will be furnished.

The following subjects were selected, upon which papers should be read: "Maintenance of Car Equipment;" "The Modern Street Railway Shop—Its Design, Machinery and Shop Practice;" "Train Service and Its Practical Application;" "Investments in Street Railways—How Can They be Made Secure and Remunerative?" "Construction and Maintenance of Railway Track."

The headquarters of the Association will be at the Auditorium Hotel and Auditorium Annex. During the visit of the committee the local companies showed them every courtesy, and between business and pleasure there were few moments unoccupied.

National Association of Municipal Electricians.

A MEETING of the Executive Committee of the Fire and Police Telegraph Superintendents' Association, was held in Boston, Saturday, Jan. 28, at the offices of the Wire Department in the old Court House, which were placed at the disposal of the committee by Commissioner Thomas W. Flood. Every member of the committee was present and much business of importance concerning the future of the association was transacted. The object of the meeting was to revise and amend the constitution and by-laws in accordance with the resolution passed at the third annual convention at Elmira, and to outline the arrangements for the next annual meeting, which takes place at Wilmington, Del., September 5 and 6; also to suggest topics for papers to be presented at that meeting.

The members of the Executive Committee are: John W. Aydon, president of the association; W. Y. Ellett, of Elmira, chairman; F. C. Mason, Brooklyn, N. Y.; W. H. Thompson, Richmond, Va.; Morris W. Mead, Pittsburg; Capt. William Brophy, Boston; Clarence E. Stump, New York, as secretary pro tem.

In order to broaden the field of work in which the association is engaged, it was decided to change the name from the "International Association of Fire and Police Telegraph Superintendents" to the "National Association of Municipal Electricians," which title renders eligible for membership all officials engaged in the electrical departments of municipalities throughout America, instead of only those engaged in the fire and police telegraph departments as heretofore. The associate members are composed of manufacturers and dealers in apparatus and appliances relating to the interests kindred to the association.

The following are the titles of some of the important papers that will be read at the next annual convention: "The Laws and Government of the Wire Department of Boston" by Commissioner Thomas W. Flood. This is the first time that Commissioner Flood has consented to personally review the very important work carried on by his department, and as Boston is the only city that has such a department, it will no doubt greatly interest and instruct not only the municipal electricians throughout the country, but the electrical public as well; "Licensing of Employees Engaged in Electrical Work and the Improvement of the Quality of Work and Material," Captain William Brophy, of Boston; "Advisability of Concentrating the Control of all Municipal Electrical Interests Under One Head," Morris W. Mead, of Pittsburg; "The Underground System as Applied to the Fire Alarm Telegraph," S. L. Wheeler, city electrician, Springfield, Mass.; "The Police Signal System of Boston," John Weigel, superintendent Police Telegraph, Boston; "Aerial Construction of Fire and Police Telegraph Lines," W. H. Thompson, city electrician, Richmond, Va.; "Progress and Development of the Municipal Electric Interests of Canada," G. F. MacDonald, Ottawa, Canada.

In connection with the next meeting of the association will be held an exhibition of electrical and mechanical apparatus used in various departments of municipal work, which will be of a very interesting and instructive character. A large building

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well adapted for this purpose has been secured and every facility will be afforded manufacturers to attractively display their goods. Ample power will be supplied for operative exhibits and a special committee will be appointed by the association to make report on the exhibits.

The Board of Trade of the city of Wilmington has taken an active interest in this feature of the meeting, and have already appointed a committee from that body to assist in making the exhibition a successful one. The railroads have agreed to make special freight rates to exhibitors. Among the displays will be one showing the various stages of progress in the municipal fire alarm business down to the present date. The first box ever used to call out a fire department will be on exhibition, and such other boxes as the state of the art evolved along progressive lines. The Montauk Multiphase Cable Company will make an exhibition of their cable in connection with all interior adaptations; telephones, district call boxes, watchman's time detector service, electric lights and Gamewell auxiliary fire alarm boxes in circuit therewith will be exhibited. The various insulating wire companies will make a display of their products, and there will also be added to the exhibition some special entertainment features.

After the work of the Executive Committee was completed, a visit was made to the works of the Gamewell Fire Alarm Telegraph Company at Upper Falls, under the guidance of Mr. W. E. Decrow, the representative of the Gamewell company in Boston. Upon returning to the city, the party was conducted through the magnificent new terminal station by Captain John Sanborn, the general manager, G. B. Francis, the resident engineer, Treasurer Coon, and Electrician Caldwell. Much interest was manifested by all in this great work, and the electrical features connected therewith, it being the most complete and largest railway station in the world.

Captain B. S. Flanders, superintendent of fire telegraph, and Mr. John Weigel, superintendent of police telegraph, conducted the visitors through their respective departments, and the party then adjourned to "The Hayward," where a most agreeable surprise in the form of an elaborate banquet awaited them. It was late in the evening before Toastmaster Brophy had secured a speech from all present, and the occasion will be long remembered by all who were so fortunate as to be present.

The following are the names of those who attended the meeting and subsequent entertainments: William Brophy, chief electrician Wire Department, Boston, Mass.; F. C. Mason, superintendent Police Telegraph, Brooklyn, N. Y.; Morris W. Mead, superintendent Bureau of Electricity, Department of Public Safety, Pittsburg, Pa.; C. W. Price, Montauk Multiphase Cable Co., New York; Walter O. Faulkner, Lynn, Mass.; B. S. Flanders, superintendent Fire Telegraph, Boston, Mass.; F. M. Ferrin, Boston, Mass.; Thomas W. Flood, Commissioner of Wires, Boston, Mass.; John Weigel, superintendent Police Telegraph, Boston, Mass.; H. F. Cottle, consulting electrician, Boston, Mass.; W. E. Decrow, Gamewell Fire Alarm Telegraph Co., Boston, Mass.; S. L. Wheeler, city electrician, Springfield, Mass.; Clarence E. Stump, City Government Publishing Co., New York; John W. Aydon, superintendent Fire Telegraph, Wilmington, Del.; W. Y. Ellett, superintendent Fire Telegraph, Elmira, N. Y.; W. H. Thompson, superintendent Fire Telegraph, Richmond, Va.; J. S. Wilson, American Circular Loom Co., Boston, Mass.; C. O. Baker, New York.

National Electric Light Association.

The proceedings of the twenty-first convention of the Association held in Chicago during the month of June, 1898, have just been published, and contain, beside the numerous interesting papers read at that convention, a very excellent likeness of ex-President Samuel Insull, which will add considerably to the great value of the work to the many friends of the Association and Mr. Insull in particular. The book, which contains 350 pages, is handsomely printed, amply illustrated, and well bound, and will find an important place in the standard electrical literature of the day.

GREENCASTLE, IND. The Putnam County Telephone Co., formed recently with a capital of $10,000, is intended to operate toll lines only, charging a toll of 1½ cents per mile, and connecting with the local Greencastle exchange. C. C. Hurst is president; J. Richardson, secretary; F. G. Gilmore, treasurer.

REPORTS OF COMPANIES

Southern New England Telephone.

The old board of directors of the Southern New England Telephone Company was re-elected at the annual meeting in New Haven Feb. 1. The directors re-elected the present officers as follows: President, M. F. Tyler; vice-president, James English; general superintendent, E. B. Baker; secretary and treasurer, A. H. Embler; assistant treasurer, E. N. Clarke. The financial statement showed earnings $644,000, and expenses $491,475.

The total number of stations in the State is 10,588, an increase for the year of 1,213 stations, and all the towns in the State except 14 of 168 towns in Connecticut are reached by the wires of the company.

During the year there was spent about $90,000 on underground work. Almost all of the old 5 per cent. bonds of the company overdue and upon which the company held an option of payment at 102, have been refunded into the new long 5 per cent. bonds of the company.

The Electric Boat Co.

The Electric Boat Co., which was incorporated in New Jersey last week, with a capital of $10,000,000, is in part a reorganization of the Holland Torpedo Boat Co. The head of the new company is Mr. Isaac L. Rice, president and a director of the Electric Storage Battery Co. The patents and good will of the Holland Co. are valued at $5,000,000. In addition to this asset, the Electric Boat Co. becomes the owner of the two submarine boats, the Plunger and the Holland, the latter of which is valued at $65,000. There is also a contingent equity of $150,000 due the Holland Co. in the appropriation of $350,000 by act of Congress, 1897, for the construction of two submarine boats. The new company will develop vigorously the use of electric boats of all kinds, and its management is noted for "getting there" by hard, persistent work.

Pennsylvania Mfg. Co.

At the annual meeting of the Pennsylvania Manufacturing Company, held last week in Philadelphia, the following directors were elected: Joseph B. McCall, William J. Latta, Charles A. Porter, Jeremiah J. Sullivan, A. V. R. Coe. James F. Sullivan presided. The stockholders ratified the directors' action in selling to the Electric Company of America, the properties which had been purchased outside of Philadelphia. The report for the eleven months of the fiscal year to Dec. 31, 1898, presented, shows: Gross $963,157, and surplus over charges for that period and October dividend, $218,598. In addition the receipts from other sources, including sales of stocks, bonds, etc., were $765,883, making total undivided profits on Jan. 1, $984,482.

The Warren—Medbery Co.

The annual meeting of the stockholders of the Warren-Medbery Company was held at the office of the company in Sandy Hill, Jan. 16. The meeting was for the purpose of electing directors for the coming year. Following is the board of directors: H. E. Tidmarsh, Geo. W. Wait, W. W. Wells, W. H. Cunningham, C. W. Kellogg, H. B. Warren and S. C. Medbery. The first meeting of the new board of directors was held after the stockholders' meeting, and the following were elected officers of the company: President, H. E. Tidmarsh; vice-president, H. B. Warren; secretary and treasurer, Geo. W. Wait.

The officers' report, concerning the past year's business, indicates a very gratifying amount of business done under satisfactory conditions, and with a very encouraging outlook for a greatly increased amount in sight for the coming year. In the first year of its existence, says the Sandy Hill, N. Y. "Herald," the company has become very well and very favorably known in the electrical trade. Its apparatus is giving perfect satisfaction. Its sales agencies throughout the entire country are well organized and the inquiries for Warren-Medbery generators are constantly on the increase. The officers and shareholders of the company considered the prospects of the company so encourag-

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ing, that they have determined to increase their capital stock, for the purpose of obtaining increased shop facilities for the manufacture of their apparatus. It is proposed to establish independent work and develop a more extended line of machinery. While the site of the new factory has not been fully determined upon, it is assured that the company will remain at this place and develop a local industry, which will ultimately prove one of the most important of Sandy Hill's manufacturing institutions.

THE STOCK MARKET.

Expansion of Industrial Credits.

One of the most noteworthy recent features of finance has been the slowing down of the stock market, while at the same time the loans from the banks have increased. This simply indicates an expansion of industrial credits, due to the greater activity in every line of commerce and manufacture, and is a distinctly good sign. In general, business everywhere is excellent, except for the interruptions of the recent severe weather. The last railroad earnings reported showed an increase of nearly 10 per cent. over last year on a large group.

During the past week 10,304 shares of Western Union sold down to 94½, and 10,840 shares of General Electric around 111. New York Edison was inactive at 196, but Metropolitan Street Railway on 53,987 shares was firm around 234. On rumors of change to electricity, Manhattan Elevated was active, closing at 111⅝. In Boston American Bell sold at 330 and West End Railway at 93.

All metals are strong. Copper was quoted last week at 18.75 cents.

CATALOGUES.

Charles E. Billin & Company.

For several months past we have been receiving copies of the very creditable pamphlet issued by the above firm entitled "Machinery and Supplies for Mines and Mills." No. 5 of the first volume, which has just reached us, is quite up to the standard of its predecessors. It contains valuable articles on: How fuel is wasted in power stations, the measurement of iron roofing and siding, descriptions of products of the American Engineering Works of Chicago, and of several other firms, serving also as advertisements for these firms and containing much valuable and instructive data.

The Electric Gas Lighting Company.

A very handsome and complete catalogue of electrical house goods has recently been issued by the above company, 195 Devonshire street, Boston, Mass. The book, which is handsomely bound, contains 136 pages, with numerous illustrations of electrical house goods and supplies. A great deal of space in the catalogue is devoted to the description of the Samson Battery, which is here offered in an improved form. Numerous other batteries, liquid, semi-dry and dry, are described. The catalogue contains a very complete index, is an extremely valuable and complete publication, and will be sent to any one on request.

The Rarig Engineering Company.

The above firm, manufacturers of the Rarig-Corliss single, compound and condensing engines, hauling, hoisting and blowing engines, boilers, etc., have recently issued a very complete catalogue of the goods which they manufacture. Numerous engines of various types are illustrated and thoroughly described, and their advantages pointed out, their dimensions, prices, weights, etc., are given, and many improvements introduced by this company are fully explained. In the back of the pamphlet are tables showing first class engine performances, tables for finding the mean effective pressure and various other valuable steam and engine data. The catalogue will be sent to any one on application.

Bates' Electric Fans.

A very neat and complete catalogue has recently been issued by D. L. Bates & Bro., Dayton, Ohio, illustrating and describing the many types of ceiling and portable fans manufactured by that company. The fans are perfectly noiseless, run in self-oiling bearings and are wound for direct and alternating currents. They can be furnished in nickel, oxidized copper or polished brass finish. Some of the types listed are the four blade ceiling fans with and without switch attachment, the two blade and electrolier ceiling fans, column fans with and without electrolier attachment, the alternating current ceiling fan and the "whirlwind" desk fan. The current consumption of the latter is .5 ampere. The catalogue also contains illustrations of the company's rheostats and a facsimile of a newspaper clipping speaking about the life and health saving properties of electric ventilators and fans. The catalogue will be mailed to any one on application.

Robbins & Myers Co.'s "Standard" Electric Fans.

A handsome book of testimonials all sounding the praises of the ceiling, desk, bracket and electrolier fans manufactured by the Robbins & Myers Co., Springfield, Ohio, has recently been compiled and sent to the trade by that company. On the cover of this effective booklet, which contains eighteen testimonials of merit, tied together by a neat pink silk cord, is a letter addressed by the company to agents and users of electric fans, wherein they ask their patrons for an expression as to what success they have had with the "Standard" electric fans. They asked for these views so that all defects, should there be any, can be corrected before the 1899 pattern is put on the market. Many of the companies report tests which they have made to determine the efficiency of the fans, and all speak very highly of their many favorable qualities, such as smooth and cool running, small consumption of current and high efficiency. The book will be sent to any one on application.

TRADE NOTES AND NOVELTIES

Bristol's Patent Steel Belt Lacing.

IT is now nearly ten years since The Bristol Company, of Waterbury, Conn., began manufacturing their patent steel belt lacing, which has become within that time familiarly known and very generally used at home and abroad. There are over one hundred different sizes and lengths adapted to different styles and widths of belting. The illustrations Figs. 1, 2 and 3 show the three different types that are made, of which Fig. 1 represents that originally placed upon the market and designed particularly for leather belts.

The type illustrated in Fig. 2 was brought out later to meet the demand for a fastener for woven belts, such as are made of cotton and rubber. In this style the distance between the rows of spurs is greater than in the original form shown in Fig. 1, and thus affords a better hold on ends of a belt of a woven or fibrous nature. Both types of the lacing shown in Figs. 1 and 2 have the patented feature that they are formed from blanks of a zigzag shape, said shape being such that the blanks may be successfully cut from a ribbon of steel without waste of material.

The latest design shown in Fig. 3, which is now being introduced, combines the special features of both of the previously described types, the essential difference being that there are two rows of spurs on each side of the centre, instead of one. The patented features of this latest design are that the blanks used are of a zigzag form and that they may be successfully cut from a ribbon of steel without waste of material, each blank,

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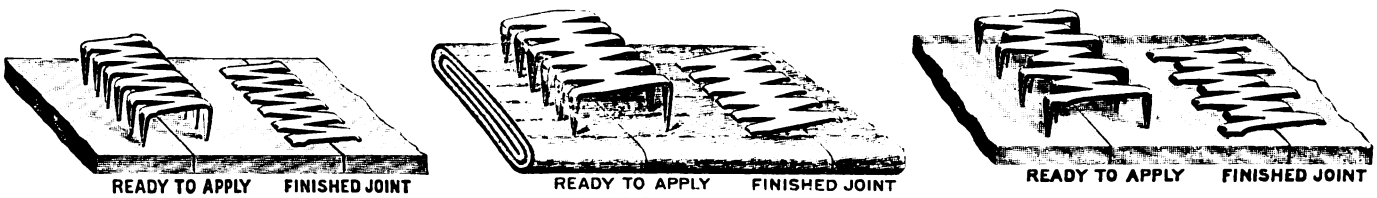
as it is cut off, simultaneously forming one side of the blank for the next lacing.

The advantages of this new form of lacing are that it is equally applicable to leather, cotton or rubber belts, and that the double rows of spurs on each side of the joint insure great strength, especially when applied to old and partially worn belts.



FIGS. 1, 2 AND 3.—BRISTOL'S PATENT STEEL BELT LACING.

All the above types have been carefully designed to give maximum strength with minimum amount of material. All three styles are easily applied without use of special tools, making smooth and elastic joints. Samples will be mailed free on application to the makers.

NEW YORK NOTES.

TRENTON, N. J. The Trenton and Princeton Traction Co. has been incorporated with a capitalization of $200,000 to build an electric railroad betwen this city and Princeton, nine miles distant. The incorporators are Ex-Senator George O. Vanderbilt of Princeton, Charles W. Shippee of Boston and Julius Garst, Elmer E. Carpenter and Henry Lincoln, all of Worcester, Mass.

PEOPLE'S TELEPHONE CO. of New York city claims that it has already 7,000 subscriptions pledged, of which 1,500 are in Brooklyn.

SYRACUSE, N. Y. Mayor McGuire's message advocates carrying out fully the plan to underground all wires by May, 1899. There are now three private subway systems in Syracuse, erected at a cost of $200,000.

FOWLER SWITCHBOARD & TELEPHONE CO., through its directors, John T. McRoy, Samuel B. Fowler and L. Victor Flockles, has applied to the Supreme Court for voluntary dissolution. Justice Bookstaver of the Supreme Court set down the order to show cause for May 2. The assets amount to $400. There are no liabilities.

THE AUTO-ELECTRIC CO. has been formed at Trenton, N. J., with a capital stock of $1,000,000 by T. M. Cheeseman of Garris, N. Y.; Nelson Hiss of New York city and Duncan T. McLaren of East Orange, N. J.

DUNCAN & EYRE is the name of a new engineering firm, with offices in the Empire Building, 71 Broadway, New York. It comprises Dr. Louis Duncan and Lieut. Manning K. Eyre, both of whom are well known in the electrical field. A large amount of important work is already in the hands of the firm.

ROCHESTER, N. Y. The State Board of Railroad Commissioners has granted the application of the Rochester and Sodus Bay Railroad Company for permission to construct an electric street surface line of railroad from Rochester to Sodus Point, on Lake Ontario, a distance of forty-two miles. The New York Central and Hudson River Railroad Company opposed this application on the grounds that the new road would parallel its road and that there was not sufficient traffic to warrant the double lines.

NEW JERSEY. At the sale in foreclosure of the Union Traction Company, operating between North Arlington and Carlstadt, N. J., W. C. Giles for the reorganization committee bought in the road for $872,000, or $20,000 more than the bonded indebtedness. The road went into the receiver's hands a year ago, owing partly to its failure to secure a franchise permitting extension into Hackensack. Contractors stand ready to complete the line, and the road will likely compete with the Bergen line for Hackensack rights-of-way.

NORTH RIVER LIGHT, HEAT AND POWER CO. has been formed at Hoboken, N. J., by A. K. Bonta, and Arthur Seitz, of Hoboken, and W. C. Anderson, of West Hoboken. Mr. Bonta has long been prominent in lighting matters in that territory and has now organized this new company.

MR. ELIAS E. RIES, the well-known consulting engineer and electrical expert, has removed his office from Temple Court to the New York Life Building, 346 Broadway, New York. Mr. Ries, together with a number of business associates, has just organized the United States Automatic Telephone Company, whose offices are in the same building. This company, whose incorporation at Albany was announced in these columns recently, has secured control for the United States of the basic patent granted to Mr. Ries upon his new and highly ingenious automatic telephone system. This novel system dispenses entirely with the hook-switch, magneto-generator, drop switchboards and other complex and troublesome features of existing systems. It not only constitutes a radical departure in telephone work, but promises to greatly cheapen the art of telephony by reason of its remarkable simplicity and convenience, its promptness and efficiency as compared with ordinary systems now in vogue, and its exceeding low cost. Mr. Ries is well and favorably known to the electrical profession as a scientific investigator and technical expert of no mean ability and his latest effort bears high tribute to his skill and originality. He has had an extended practical experience as an inventor, and in a great many lines of electrical development he has done original work. Mr. Ries is an active member of the American Institute of Electrical Engineers, the New York Electrical Society, and other technical associations, and has been a frequent contributor to the electrical and engineering press on various topics.

NEW JERSEY ROADS. Mr. Henry I. Budd, the progressive Commissioner of Roads for the State of New Jersey, has just issued his annual report showing how rapidly the roads are improving. An interesting feature is that the report includes as a special insert the group picture of Woods electric carriages, published recently in The Electrical Engineer. Probably this is the first State report in which automobiles have appeared.

BEACON LAMP COMPANY, of New Brunswick, N. J., which went lately into the hands of a receiver, is, we hear, reorganizing under very favorable conditions, and will without delay be ready to fill orders for lamps. Mr. Moses says it will have some valuable new specialties on the market at once and will push things.

SIDNEY, N. Y. The Union Telephone Co. has been incorporated, capital $10,000, to build and operate lines and exchanges in Delaware, Otsego and Chenango counties, by D. R. Buckley and E. O. Allen, Unadilla; M. L. Siver and John Spickerman, Sidney, N. Y.

UNADILLA, N. Y. The Standard Light and Power Co., of Unadilla, have their plant in operation, consisting of three 56-inch turbines, giving about 400 h. p. D. R. Buckley is interested.

THE EAST JERSEY WATER CO., of Little Falls, N. J., have recently purchased an 80 h. p. vertical engine from the Ball Engine Co., Erie, Pa.

WESTERN NOTES

THE ELECTRIC APPLIANCE CO. desire to call the attention of every one in the electrical profession to the map of Chicago's business district shown in their advertising announcement. This is one of the plainest maps of the downtown part of Chicago yet published, and from it our readers may get a good idea of the new location at 92 and 94 West Van Buren street. The cable cars, which can be taken any place on the "loop" shown on the map, are within convenient distance of the hotels, and they all go past the doors of the Electric Appliance Co.

CREHORE-SQUIER CO. has been formed at Cleveland, O., with a capital stock of $1,000,000 to develop the "sine wave"

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system of telegraphy bearing the name of these two inventors. Associated in the enterprise with Lieut. Col. A. E. Squier is Mr. H. A. Garfield, son of the late President Garfield.

SILVER CITY, N. M.—The New Mexico Light, Heat and Power Company, of Silver City, New Mexico, have recently installed two Northern Electric generators direct connected to engines built by the Ball Engine Company, Erie, Pa.

THE PERRY-PAYNE BUILDING, one of the most prominent in Cleveland, Ohio, recently added to their electric plant a 50 k. w. Walker generator direct connected to a 100 h. p. engine built by the Ball Engine Company, Erie, Pa., who have already two engines in this plant.

CHASE CONSTRUCTION COMPANY have removed to suite 1321-22 in the Majestic Building, Detroit, in order to secure more commodious quarters for their business as general electrical contractors, etc. Mr. Geo. E. Fisher is president and treasurer. Mr. O. D. Chase, secretary and chief engineer, and Mr. E. N. Chase, superintendent.

MULLINIX ELECTRIC COMPANY, of Cincinnati, O., have removed to Hamilton, O., and have changed their name to the Snively-Mullinix Electric Company. They are now located on the corner of Dayton and Water streets in Hamilton, where they are manufacturing a line of electrical specialties, including their well-known dynamo and motor brushes. They intend at an early date embarking in the supply and construction business, and desire to hear from manufacturers of such goods. Mr. I. D. Snively, of Hamilton, joins Mr. C. L. Mullinix in the new venture under their joint names.

THE BALTIMORE HOTEL, of Kansas City, Mo., has ordered a direct connected outfit, consisting of one 75 and one 60 k. w. General Electric generator, each direct connected to engines built by the Ball Engine Co., Erie, Pa.

BRAZIL BLOCK COAL CO., Coxville, Ind., have recently purchased for their electric mining plant a 150 h. p. engine, built by the Ball Engine Co., Erie, Pa.

NEW ENGLAND NOTES

HARTFORD, CONN. State Treasurer Merrick has taken the control of the Hartford and West Hartford Horse Railroad Co. in the interest of the first mortgage bondholders, as authorized specially by law. It is expected to pull out in good shape.

THE EASTERN ENGINE COMPANY is the new name of the corporation which purchased the property of the Armington & Sims Engine Company, and which is now building engines of that type, with recent changes and improvements.

TRUMBULL ELECTRIC CO., of Hartford, Conn., will buy, sell and install new and second-hand dynamos and motors. It will also carry on a general repair business and engage in electrical construction. A line of supplies will be carried. The officers are J. H. Trumbull, general manager and treasurer; W. S. Ingram, president, and Henry Trumbull, secretary and superintendent.

SOUTHERN NOTES

FORDSVILLE, KY. The Fordsville-Harrison Telephone Co. has been formed, comprising three local companies or systems. It has 75 miles of circuit and will have from 50 to 100 drops in use by next May. The lines will be extended to Owensboro, Ky., to connect with those of the Harrison exchange there. The capital stock is $1,000.

KINGSVILLE, KY. The Kingsville & Stanford Telephone Co. has a small system with three toll lines, supplied by the Western Telephone Construction Co. There are fifteen miles of circuit. W. L. McCarty is president.

BALTIMORE, MD. The general consolidation of all the lighting and railway properties in Baltimore will take $76,000,000. There will be $38,000,000 fifty-year 4 per cent. gold bonds, $14,000,000 cumulative preferred 4 per cent. stock, and $24,000,000 of common stock.

HILL BROS. & CO. has been formed at Waco, Tex., by B. H. Hill, A. S. Hill and G. Phillips, with a capital stock of $10,000, to carry on a business in electrical and kindred supplies.

MANILA CABLE. The United States Attorney General has filed an opinion that the government is in no way liable for damages because Admiral Dewey cut the cable at Manila.

WESTINGHOUSE ENGINE GOVERNOR. We wish to correct the statement in a recent advertisement of the Westinghouse Machine Company, which was due to a typographical error, that Westinghouse engines are "fitted with water governors." They are equipped with the well-known "inertia" governor which is recognized as of the best.

THE WESTERN ELECTRIC CO., Chicago, are offering a list of second-hand apparatus in good condition which they wish to dispose of as quickly as possible, as they need the space in which it is stored for manufacturing purposes. The list includes arc dynamos, motors, arc lamps, etc. It is all in Chicago stock, and can be shipped at once.

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Department News Items will be found in advertising pages.

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The Electrical Engineer.

Vol. XXVII. FEBRUARY 23, 1899. No. 564.

MISCELLANEOUS

Electricity on Board Ship.[1]

BY LIEUT. COMDR. S. DANA GREENE.

WHILE the title of this paper is intended to cover the applications of electricity aboard ship in the merchant marine, as well as in the navy, I shall confine myself principally to the war vessel; for the service requirements of electrical apparatus on the latter are quite as severe as on the former, while the limiting conditions as to weight and space are much more severe. It may be safely assumed, therefore, that any application which can be made to advantage aboard a man-of-war will be equally advantageous on board a merchantman.

On shore, the advantages of centralizing the manufacture of electric power for industrial purposes in one plant, distributing this power by suitable means to individual consumers, are so well known, and the industry is so well established, that it seems hard to realize the fact that it has all been accomplished in less than twenty years, and that it is less than ten years since it was a difficult matter to interest capital in such undertakings.

For several years after the industry was well established ashore, little or nothing was done aboard ship. This was due principally to two causes:

First. Seafaring men are notoriously conservative about introducing new ideas or new apparatus aboard ship, which may not prove successful, and which may on the other hand fail in the middle of a long voyage when facilities for repairs are not at hand and when a breakdown may be a very serious matter to the safety of the ship or the lives of the officers and crew. This conservatism is particularly strong in the British navy, the greatest in the world, where no machinery is ever introduced when the work can be done as well by hand, and where "simplicity" is the first requirement for all machinery.

The modern warship is a complex piece of mechanism at best, and I think the established policy of our English cousins to eliminate rigidly all unnecessary complications is wise; one that can well be followed by other navies and particularly our own, where there has been a tendency to introduce too many novelties and labor-saving devices, at the expense of simplicity and safety.

Second. Electrical men, while generally unfamiliar with the conditions of sea life, knew nevertheless that three great enemies of electrical apparatus—salt air, moisture and heat—were always present aboard ship, and they feared them.

However, the great advantages of electric lights gradually overcame the sailor's conservatism and the electrician's fears, and lighting plants have been generally installed aboard ship for several years, in spite of numerous troubles at first both with the apparatus and with the wiring.

The great advances made in the construction of electrical apparatus and the methods of distribution, enable us to say to-day, and to prove as I shall hope to prove, with a full knowledge of service conditions, that electrical applications can be made with as little fear and with as great certainty of success aboard ship as they can ashore.

The recent position reported to have been taken by one of the Naval Bureau Chiefs that such applications should not be further extended on our warships at present, because we did not have the trained men to care for the machinery, is, it seems to me, absolutely untenable. If it is demonstrated that an electric motor is better adapted to drive a deck winch, for example, than a steam or hydraulic or compressed air motor, then it should be installed, and the necessary men to operate it can and should be obtained. If the course suggested by the naval officer referred to had been followed in our navy for the past fifty years we would still have sailing vessels (the frigates and line-of-battle ships of Nelson's day), and our recent unpleasantness with Spain would have terminated with very different results.

Assuming then, as every reasonable man both in and out of the navy does assume, that electrical apparatus can be made to work on shipboard, let us examine the conditions of the modern war vessel as we find them, and see where electricity can be advantageously introduced, having in mind always the necessary requisites—safety, simplicity, efficiency and reliability.

The modern first-class battleship requires about 2,000 i. h. p. to drive all the auxiliaries at full load, and the first-class cruiser about 1,200 i. h. p. These auxiliaries, however, are never all in use at the same time, using maximum power, and it can be assumed that about one-half these amounts (i. e., 1,000 i. h. p. and 600 i. h. p.) will be required at any one time. They are scattered all over the ship, from the anchor hoist forward to the steering engine aft, and from the deck winches and boat cranes on the spar deck to the bilge and fire pumps in the engine and fire rooms, 30 or 40 feet below. Some of them, such as condenser, air, circulating, feed, bilge and fire pumps, and fire-room blowers, are necessarily located within the engine and boiler room compartments, where the temperatures are always high, and where steam, oil, water and coal dust are always present in greater or less quantities. Others, located on the spar deck, are exposed to salt water and air and to the varying conditions of sea and weather.

With these scattered locations, it is obvious that power, generated at a central point, must be distributed throughout the ship. For this purpose there can be used either steam, hydraulics, compressed air or electricity. Hydraulics and compressed air not only have a low efficiency of conversation (from steam), but it is difficult to prevent leaks, freezing, bursting of pipes, etc. They have both been tried to a limited extent and both found wanting in service.[2] This leaves steam and electricity as the two remaining systems of distribution from which to choose. As between the two, steam has the following disadvantages:

First. Danger to life. The bursting of a steam pipe, whether in or out of a fight, is a serious matter, and likely to disable any of the crew who are in the compartment where the accident occurs. It has been abundantly proven in our Civil War, that men will not stand up against steam or hot water, when they will face shot and shell without flinching. Many of our vessels operating in inland waters during that war had several lines of hose coupled to a hot water tank and led out every night to guard against boat attacks. These hoses were successful on more than one occasion in repelling boarding parties. While the main steam leads fore and aft can be run below the protective deck or behind the armor belt, vertical branches must run to all auxiliaries on the upper decks, and many of these must be used in action. The effect of a steam pipe carrying 100 pounds pressure, bursting or being shot away in a compartment where there may be 30 or 40 men, at the guns or passing ammunition, would undoubtedly be to kill or disable every man in the neighborhood and demoralize thoroughly that part of the ship. On the other hand, if a wire is shot away, one or more auxiliaries may be disabled but no one is injured; furthermore, the wire presents a much smaller target than a steam pipe, and is therefore less liable to injury from shot. It is always a difficult matter, too, to keep steam and exhaust pipes tight and to prevent leaks at the joints and at watertight bulkheads.

Second. Injurious heating of living quarters. Steam and exhaust pipes must necessarily run to every auxiliary, and some of the latter, such as the ice machine, anchor hoist, steering engine, ventilators, etc., are in the officers' and men's quarters, or the pipes leading to them must pass through these quarters. The heat of the pipes and engines not only makes the quarters uncomfortable, but it is impossible to prevent more or less oil and dirt around the auxiliaries. In the tropics, the heat is often so great that the officers and men cannot sleep below at all. This was the case on a number of our vessels operating in Cuban waters last summer.

Third. Efficiency. Here the contrast is very striking in favor of electricity, surprisingly so to one who has not seen the actual economy figures of steam auxiliaries. Some data will be presented on this subject later on.

[1] Paper read before the A. I. E. E., Jan. 25, 1899.

[2] Benbow's experience with hydraulic turret machinery.

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There remain the two important factors of simplicity and reliability to be considered. No one who has had experience with the modern well-designed and well-insulated carbon brush generator or motor, can have any doubt as to its greater simplicity as compared with the steam engine. There are no joints to keep tight, no nuts or bolts to set up, no packing to renew, no cylinders to cut, and only two self-oiling bearings, as compared with a dozen or more oil cups on an engine. In fact it is difficult to imagine a simpler piece of machinery than the modern dynamo. It seems like a return to elementary principles to discuss such a point; and yet many men aboard ship imagine the dynamo a most complicated affair, simply because they know nothing about electricity and think everything connected with it is mysterious and complex. This feeling is not confined to seafaring men, as we all know.

The question of reliability is a vital one, for no matter what the advantages with respect to safety, economy and simplicity may be, if the electric auxiliary cannot be relied upon at any and all times to do its work it is a failure and must be discarded. It must not only be able to work well under normal and favorable conditions, but it must also be able to stand a certain amount of abuse and neglect. Stress of weather and other conditions, particularly during a war, sometimes play havoc with the established routine of a ship, and the sailor's tools must not only be sound—they must be hardy. The normal conditions aboard ship are not favorable to ordinary electrical apparatus, as has been explained, but this simply means that apparatus for such work must be specially designed and built to meet these conditions. The ordinary motor would not last long under a street car; nevertheless thousands of car motors are built and sold every year which run day in and day out with a remarkably low maintenance account. Similarly, apparatus for ship work must be specially insulated, a larger margin of capacity must be allowed, and in exposed places it must be thoroughly enclosed. Several years ago an English manufacturer asked permission to install an electric deck winch on the spar deck of a new cruiser, fitting out at Portsmouth. When the captain who was superintending the fitting out of the ship saw it, he gave orders to have the deck hose turned on the motor for ten minutes, and then to operate the winch. The manufacturer protested, and said that the motor was not intended to be abused in that way. "Then take it off the ship," said the captain, "for I cannot guarantee that we will ship no seas during our cruise, and I want that winch ready for service whether we ship seas or not." The captain was quite right; the motor was taken off and a "rough and ready" steam motor substituted.

Experience also is the final test of reliability, and fortunately we have some experience in our navy on which to rely. During the late war, all of our regular war vessels were fitted with electric lighting plants, and many of the larger ships were supplied as well with certain electric auxiliaries; such as ventilating fans and ammunition hoists. Two of the "Brooklyn's" turrets were controlled by steam motors, and two by electric motors. So far as I have been able to learn, from both official and unofficial sources, all the electrical apparatus on these ships stood the supreme test of battle admirably, and the officers of the "Brooklyn" are enthusiastic over the performance of the electrically controlled turrets. They report that with respect to ease of manipulation and fineness of control, there is no comparison, but rather a contrast. This is high praise from competent authority, for the officers referred to had actual command of the turrets in battle, and their judgment is not only unprejudiced and impartial—it is final and conclusive.

It is hardly necessary to say that electric machinery to be reliable must have reasonable care and attention from men who know something about it. The same is true of any machinery, and it is bad policy, as well as untrue, to say, as is sometimes said by those who should know better, that an electric motor requires no attention. Cleanliness is very necessary, and may be considered as a first essential to successful operation. It is astonishing to see how little has to be done to an electric motor if it is kept scrupulously clean; but this cleaning must be regular and intelligent. From what has been said, it may safely be affirmed that electric machinery can be made as reliable on shipboard as any other machinery, and with this in mind we can turn to the question of efficiency, including weight of plant and first cost.

There has been very little data published on the performance of ship auxiliaries, but a valuable contribution to the subject appeared in the February (1898) number of the "Journal of the American Society of Naval Engineers," by P. A. Engineer W. W. White, U. S. Navy, entitled 'Steam Consumption of the Main and Auxiliary Machinery of the U. S. 'Minneapolis.'" This vessel, as is generally known, is a first-class protected cruiser of about 7,500 tons displacement, with three screws (each operated by its own engine), and a trial speed of over 22 knots per hour. She represents the highest type of her class, and is in every way a credit to her designers and builders. She has between thirty and forty steam auxiliaries, and more than 150 separate steam cylinders. Her only electric auxiliaries are the lighting generators and a few small ventilating sets and ammunition hoists. In order to ascertain the steam consumption of her main engines and auxiliaries, Mr. White, who was serving on board the "Minneapolis" at the time, as one of her engineers, made a series of careful observations during a run of the vessel of seven days from Gibraltar to League Island, Philadelphia. Indicator cards were taken on all auxiliaries fitted for the purpose (31 in number), and the losses from leakage, condensation and radiation were carefully estimated and the water evaporated carefully measured. The results obtained are given in tables from which it will be seen that the average weight of steam used by the main engines per hour was 33,620.6 lbs., and by the auxiliaries, 10,146.7 lbs. That is, the auxiliaries consumed nearly 25 per cent. of the total coal used. The main engines consumed an average of 20.63 lbs. of steam per i. h. p. per hour, and the auxiliaries an average of 119 lbs. per i. h. p. per hour (the lowest being 55.06 lbs., and the highest 318.68 lbs. per i. h. p. per hour). An examination of the tables shows that the steam consumption of the same or similar auxiliaries varied greatly, due doubtless to the varying conditions of packing rings, borings and valves, and of the load. These results are not exceptional; in fact they are probably better than the average obtained on most warships or merchant vessels. The new British cruiser "Powerful," (14,000 tons displacement), is reported to have used 8,300 tons of coal, from England to Hong Kong, of which 3,400 tons (or over 40 per cent.) were required for the auxiliaries.

Under the most favorable conditions the auxiliaries of a large ship probably consume at least 20 per cent. of the total coal and water used. This is more than twice as great as the consumption in a modern central station, and there is no good reason why as good results should not be obtained afloat as ashore.

Let us assume a required central station capacity for a first class battleship of 1,000 h. p. effective at the motors. The present standard e. m. f. for naval installations is 80 volts, and for the merchant marine about 100 volts. This low voltage was originally adopted on warships on account of the searchlights, which require 50 volts only, and it was desired to introduce as little dead resistance as possible. At this time no motors were of course in use, and the electric plant was used for lighting exclusively. Such a voltage is, however, entirely unsuited for a 1,000 h. p. plant. The weight of the distribution system would not only be excessive, but the size and weight of the generators would be prohibitive. The three-wire system of a standard of 220 to 250 volts two-wire system should be adopted, using the necessary resistance in the searchlight circuits when they are in service. Since they require a relatively small percentage of the total plant capacity, and are not regularly in use, this can be done without undue sacrifice.

The generating plant should consist of several units of the same size, so that parts are interchangeable, each unit consisting of a compound vertical engine driving a pair of generators or a single generator, depending upon whether a three-wire or a two-wire system is used. Assuming an efficiency of 82 per cent. for engine and generator and an average line and motor efficiency of 80 per cent., the total efficiency of the system (between the i. h. p. of the generating engines and the effective h. p. of motors), is 65.6 per cent. In other words, to develop 1,000 h. p. at the motors will require 1,500 i. h. p. at the engines, or about 900 k. w. generator capacity. Six sets of 150 k. w. each, with one in reserve, would be required. A good compound engine working at approximately full load (and with six units, those in actual service can always be operated at or near full load), will require 20 lbs. of steam per i. h. p. per hour. Assuming a total efficiency of the system of 65.6 per cent., as above, it will require about 30 lbs. of steam per effective h. p. per hour at the motors. If we allow 25 per cent. margin for losses due to steam leakage, condensation, mechanical friction of gears, etc., we still have an economy of 37.5 lbs. per h. p. per hour, as against 119 lbs. as shown by the "Minneapolis" test. In this case the auxiliaries tested aggregated 471 h. p. developed, using 56,049 lbs. of water

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per hour. At 8 lbs. of water evaporated per pound of coal, the coal consumption was 7,000 lbs. per hour, or 84 tons per day, assuming that this power was required for 24 hours. If the water consumption had been at the rate of 37.5 lbs. per i. h. p. per hour instead of 119 lbs., the coal used per day for these auxiliaries would have been 26.5 tons, a saving of 57.5 tons, or nearly 70 per cent.

It is fair to assume that by the introduction of compound engines and improved mechanical appliances on some of the auxiliaries, the average steam consumption can perhaps be reduced to 75 lbs. per h. p. per hour, but this is still 100 per cent. in excess of that required for the electric drive. Assuming an average daily use of 800 h. p. effective at the auxiliaries on a first-class battleship at sea, this difference in efficiency means a saving in water used of 360 tons per day, and in coal a saving of 45 tons per day. All steam cylinders connect with the condensers, so that the water used by the auxiliaries is not lost but is used over and over again, it being necessary to supply only that lost by leakage in the pipes and condensers. The extra pumping duty is large, however. The coal saved, on the other hand, means that with a given coal endurance (or "steaming radius") a vessel can carry from 10 to 20 per cent. less coal, or expressed in another way, with the same coal capacity, she will have from 10 to 20 per cent. greater steaming radius. The average price paid in the navy for coal (including stations in all parts of the world), is probably at least $7 per ton. There is therefore in the case assumed a direct saving in running expense of $315 per day for coal alone. It may be argued that a vessel in port does not use her auxiliaries to the same extent that she does at sea, and that, therefore, the comparisons made are misleading. This may be true as to actual savings in pounds of coal and water or in dollars and cents, but the percentage differences hold true in any case. Furthermore, a ship is built to keep the sea and her efficiency and usefulness are measured by her performance at sea and not when incidentally or accidentally in port. Her weights are distributed and apportioned, and her power, speed and "steaming radius" are designed for sea conditions, and it is these conditions alone which should be considered.

The weight and space required for plant are important matters, for a modern steamship, and particularly a war vessel, has every available inch of space and pound of weight carefully allotted; and it is sometimes difficult for the designers to adjust the conflicting elements (which may be equally important) so as to provide for all and still keep within the prescribed limits. The present weight of steam auxiliaries of a first-class battleship, assuming a total capacity at full load of 2,000 h. p. as before, is about 200,000 lbs., or 100 tons. If the electric drive is used we must add the weight of the generating plant. The navy specifications limit this weight at present to one-third of a pound per watt of rated capacity. With 1,050 k. w. capacity (six units of 150 k. w. for service and one for spare), the weight would be 350,000 lbs., or 175 tons. The electric auxiliaries would weigh about the same as steam, or 100 tons, a total of 275 tons as against 100 tons for steam drive. There would be some saving in the wiring, as against steam and exhaust pipes, so that it may be assumed that the electric plant, with the generating sets described, will weigh between two and one-half and three times the steam drive. As an offset, however, we have the saving of 10 to 20 per cent. in coal required for a given steaming radius, which in a ship of this class would amount to between 200 and 400 tons. Furthermore, if in the future a satisfactory steam turbine comparable in economy with the compound engine, is developed for marine work, as now seems probable, the weight of the generating plant will be reduced 40 or 50 per cent., and then the electric drive will compare favorably in this respect with steam, and there will still be the saving in weight of coal required for a given endurance.

The space necessary for plant must be considered as one of the vital parts of the ship, and as such it must be located below the protective deck. At first thought it may be said that it will be difficult to find the necessary space, but it must be remembered that the space required for 200 to 400 tons of coal is available, in addition to the space at present allotted for dynamo room, and these combined will certainly be more than sufficient.

The application of the electric drive to the various ship auxiliaries must be carefully studied in each case. The problems involved, however, are not more difficult than many special applications on shore, nor is there anything about them which a competent electrical engineer, with a proper knowledge of sea conditions, is unable to solve. The first cost will undoubtedly be greater than with the steam drive, but the savings in "operating expense," if capitalized, will much more than offset this difference in first cost.

The problem is purely an engineering one, and should be approached in a business-like way. Will the electric drive be equally safe, simple and reliable, and will it be more efficient than the present system of steam drive? This is the question in a nutshell, and I believe that the figures and data which I have presented enable us to answer it most emphatically in the affirmative. Other nations, particularly England, Germany and France, have already introduced the electric drive extensively on their ships, both in the navy and in the merchant marine; and it is earnestly to be hoped that our own navy, with its magnificent ships, officers and men, of whose record we are justly proud, will not lag behind in this important respect. Once provide the proper tools, and there need be no fear in this country that the necessary men to handle them properly will not be found.

I have not touched upon some of the minor electrical applications which have been made aboard ship, such as searchlights, range finders, engine room telegraphs, speed and helm indicators, signal sets, telephones, etc., etc. Some of them, such as the signal sets and searchlights, are of considerable importance both from the military standpoint and for navigation purposes, and have stood the test of service admirably. Others, like the range finder and telephones, while of great utility, have not yet demonstrated that they can be relied upon at all times; while others still may be considered as luxuries (sometimes of doubtful utility), rather than necessities. All of them come within the province of the electrical specialist, rather than the electrical engineer, and have no direct bearing on the main problem discussed in this paper.

Storage Batteries and Railway Power Stations.[1]

BY ROBERT McA. LLOYD.

A DIFFICULTY confronting us is that very few operators of railway power stations have any data showing what they are doing. Electric light managers seem to take more interest in the output of their stations, and in many cases maintain a system of records of work done, but the manager of a trolley road is usually contented with superficial observations of the switchboard and the comforting fact that the cars are running.

We always find these managers greatly surprised when the actual state of affairs is shown to them on paper, and I believe that this Institute would be astonished at the results of a thorough research into the load curves of the railway plants of the entire country. You are of course prepared for the statement that the average load on a railway power station for a given period is much less than the maximum load occurring during that period and much more than the minimum, but it is not generally understood that the maximum load for the same period is apt to be far below the capacity of the generating plant in operation. As an illustration of this fact I show in Fig. 1 some data on a typical railway plant when 35 cars were running. We have not discovered any railway plant where this is not true and I believe that the data on most of the railway plants of this country will confirm my statement. The first explanation of this would be that such a surplus capacity is necessary for reserve to meet emergencies, but I do not find it to be a useful reserve, and shall refer particularly to Fig. 1, taking this station because from the standpoint of the manager, engineers and attendants it is dangerously overloaded, and has no reserve. In fact it was necessary to add to the capacity at once to make it safely operative.

I obtained these data on the day of heaviest travel in the whole year. It will be noticed that the highest point reached was within the capacity of the main station, and yet it was necessary to start up an auxiliary station. The central solid line shows the average load, and the upper and lower lines show the limits of the fluctuations occurring from moment to moment. The method pursued in getting these curves was to divide the day into half hours, and during the first five minutes of each half hour take the highest and lowest ammeter reading in each minute; these readings are plotted in the upper and lower curves; also to take ammeter readings every five seconds and obtain the average of these readings as the point in the curve of averages. Another convenient method of obtaining the curve of averages is by wattmeter readings. Among some of the interesting feat-

[1]Abstract of a paper read before the A. I. E. E., Feb. 15, 1899.

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ures in this diagram may be noticed the fact that the nominal capacity of the generating apparatus was about 400 k. w. in excess of its maximum output occurring at about 8 o'clock in the evening, and that the average output at this time was about two-thirds of the maximum. The excess of nominal capacity was not so great at 7 o'clock in the morning, or two in the afternoon when other high points occurred, but as it was known that the morning peak would be of short duration the engineer decided to run through it without the auxiliary station, and in the afternoon the load increased more rapidly than was expected, and the auxiliary was not ready to go into operation on short notice, consequently obliging the main station to groan under a dangerous load for an hour or so.

It will doubtless occur to some that this station apparatus has been overrated, or that the engineer was incapable, or overcautious, but the fact remains that similar data are obtained in very many stations, and that in many cases the apparatus has been subjected to satisfactory tests before acceptance by the purchasers. It may be possible to build engines which regulate at all conditions of load and at the same time use steam satisfactorily at maximum load, but I do not find such engines commonly in use. Further than this there are many very good engines in use which cannot be safely operated at anything like maximum load if that load is liable to sudden variations. I realize that you may suggest all sorts of schemes for getting a better output from the plant illustrated by this curve, and you may wish to ask some questions about this apparatus, but experience convinces me that the men who are most likely to be consulted about such a station will recommend more generating plant, and the truth is that there are so many good salesmen pushing engines and dynamos that station managers frequently fail to get full duty from the machinery which they are operating already. It is not merely that the storage battery has been neglected, but any of us can see in railway power houses throughout the country, where the managers have been persuaded to increase their generating plant when attention to a few details such as steam piping would have brought their output up to requirements. Assuming, however, a station equipped with the best obtainable apparatus, and operated under the most advanced laws of station practice, in the absence of a storage battery, there would still be much more apparatus running than would appear necessary from the load diagrams.

The generator salesman says in reply to this proposition that his apparatus is cheap, and that it is good to have plenty of it, but one generally finds that where there is plenty of apparatus available, the engineer is tempted to keep too much of it running, and therefore running at low efficiency.

Of course railway power stations have individual characteristics, and it will not do to assume that they all need storage batteries, but there are certain features of railway power requirement, which are common to the problem everywhere, and which invite consideration for the storage battery.

The curve characteristics of electric light supply are well known, and much information about electric lighting has been brought out in the committe reports of the National Electric Light Association for 1896 and 1897 and by Mr. Hammond in his paper before the British Institution of Electrical Engineers in March, 1898, but the possibilities are more varied in railway work, and as far as I know, there has yet been no systematic research into the economy of railway power stations, the only published data on the subject being contained in the paper read before the Street Railway Convention at Boston last September by Mr. R. W. Conant.'

In my endeavor to point out some of the uses for a storage battery I shall take as a typical station that shown in Fig. 1. It is located in a Pennsylvania town of 50,000 inhabitants. The railways radiate from the centre of the town to distances of three to nine miles. There are six branches and the power station is

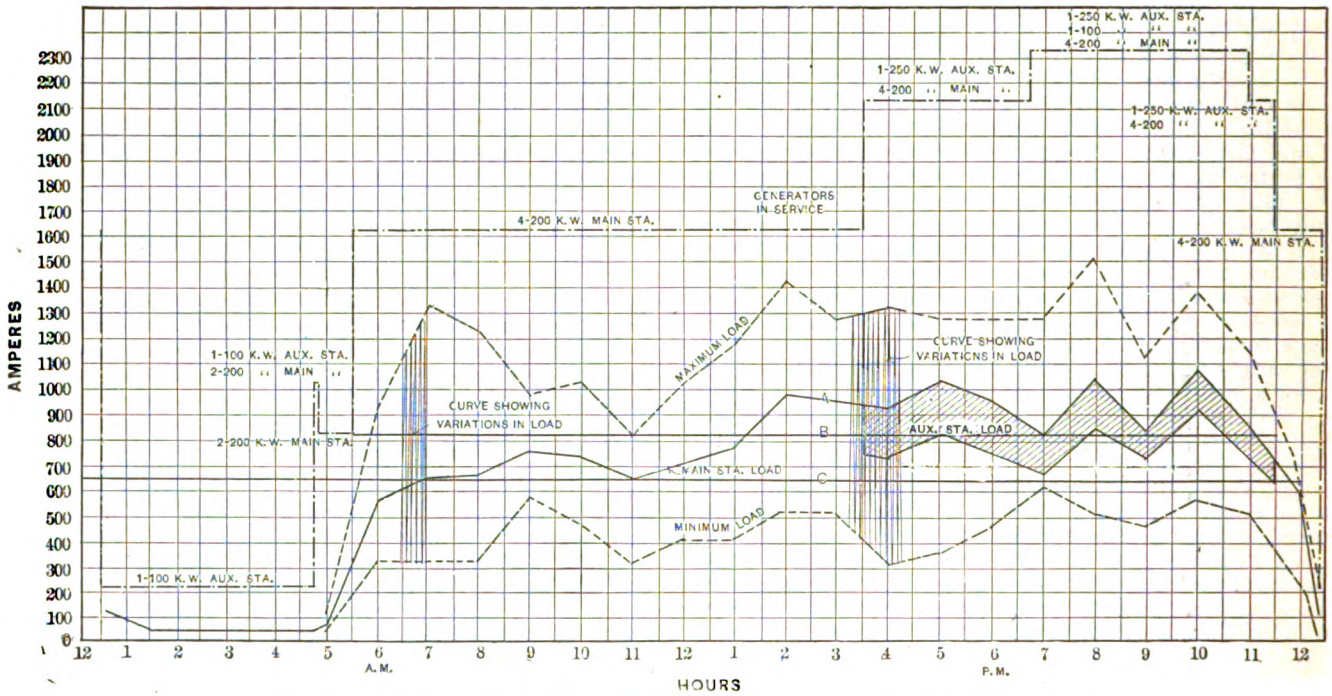

FIG. 1.—CURVES SHOWING VARIATION OF SPECIAL SATURDAY LOAD.

located two miles out on the longest branch. It has railroad and water frontage. The small auxiliary power house is the result of a recent consolidation and is close to the main house. There are three distinct ways of using a storage battery with this power plant. Taking up the figure we find first the great fluctuation between night and day load; second by the fluctuations occurring from hour to hour; and lastly the superimposed fluctuations occurring from moment to moment. We shall call a battery of sufficient capacity to level off the night and day fluctuations "large;" a battery for levelling the hour to hour fluctuations "medium;" and a battery to level the momentary fluctuations "small." It will be seen at a glance that the small battery will reduce the requirements of the generating plant to a capacity sufficient to meet the demands of the average load shown in curve A. The battery must be able to discharge at 650 amperes for momentary periods, but its capacity in ampere hours is unimportant. It will cost less than generating capacity for the same work, and a large part of the excess of capacity over requirements shown in the diagram will be saved. It will save some depreciation on the generating apparatus, and its own depreciation will not cost more than the depreciation of generating apparatus of similar capacity. It will have sufficient storage capacity to run a few night cars and lights when the engines are shut down. If located at a point nearer the centre of feeder

[1]The Electrical Engineer, Sept. 29, 1898.

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distribution than the location of the generating station, a saving in copper will be effected. Inasmuch as the investment will not be increased by including such a battery in this railway outfit all the saving in fuel due to a steadier load and the operation of less generating machinery will be clear gain to the credit of the battery.

Line B at 810 amperes shows the average load for 18 hours of the day and a "medium" battery to reduce the load to this straight line would have a capacity of 1,300 ampere hours. It will cost about twice as much as a "small" battery, but will not add enough to the cost of the installation to bring the investment up to the total now in generating apparatus alone and presumably necessary if no battery is used. This battery will have all the advantages of the small plant with wider limits of operation. The station circuit breakers may be set 650 amperes higher, and there will be greater convenience throughout the station in operating at a fixed load. There will be a marked effect on the efficiency of all departments of the station, and all the apparatus will yield a higher output in proportion to investment and cost of operation.

TABLE REFERRING TO FIG. 1.

Lay out with	Cost of generating apparatus.	Cost of Storage Battery.	Total cost of station plant.	Cost of coal per day.	Cost of coal per annum.	Saving in coal.	Saving in coal and saving in int., 5 p. c.
1—No battery.....	$115,000	$	$115,000	$30	$10,950	$	$
2—Small battery..	60,000	20,000	80,000	25	9,125	1,825	3,575
3—Medium " ..	50,000	35,000	85,000	20	7,300	3,650	5,150
4—Large " ..	40,000	70,000	110,000	15	5,475	5,475	5,525

CONTINUATION OF TABLE.

	Cost of real estate and buildings.	Repairs and depreciation.	Saving in labor per annum.	Saving in water, oil, waste, etc.	Total Saving.	Estimated addition to receipts.	Net advantage in operation.
1—	All	All		$	$	$	$
2—	the	the		100	3,675		3,675
3—				200	5,350	1,000	6,350
4—	same.	same.	$1,200	300	7,025	5,000	12,025

Line C at 650 amperes shows the average load for 24 hours and a "large" battery capable of levelling off this load will have a capacity of 3,000 ampere hours. It will cost approximately twice as much as the "medium" battery and will have all of its advantages. It will cost as much as the generating machinery displaced by it. It will add largely to the flexibility of the station. This battery could be discharged momentarily at 3,000 amperes which will put the circuit breaker limit of the station at about 3,600 amperes instead of 2,300 with all the present apparatus. It may be discharged at 1,500 amperes for one hour which will be sufficient to cover load peaks that would stall the 1,150 k. w. generating plant completely.

In cases of extreme necessity the entire system might be carried by this battery for several hours. The ability to carry sharp peaks is a distinct addition to the earning power of the system. Such peaks often signify the collection of fares which would be lost if the system were not flexible, and some managers keep up enough station capacity to carry a few holiday crowds while for 99 per cent. of the whole year it is earning nothing. Other managers do not attempt to carry special crowds. The large battery will give the manager an opportunity to get all the money that can be made out of such business without feeling that he has made any investment for the purpose. Of course the capacity of the system is limited also by the investment in copper, but in many cases the battery may be located so as to facilitate the distribution of power.

There is no reason why a railway power station of this capacity running night and day at a constant load should not attain a fuel economy as high as that of the well known Chestnut Hill Pumping Station at Boston which would be equivalent in electrical work to 557 watt-hours per pound of coal. Curve A, Fig. 1, shows for 1 day's work 7,800,000 watt-hours which required at the above rate 7 tons of coal, and assuming that the battery would only have 75 per cent. efficiency, and that 25 per cent. of the entire day's work would go through the battery, ½ ton of coal would be added to this consumption, making 7½ tons of coal per day for this plant running with a large battery.

The battery efficiency in such service as this has been found in most cases much higher than 75 per cent., and in some cases over 90 per cent., so my estimate is clearly on the safe side.

On the day when these data were obtained, 15 tons of coal were burned, or twice as much as would be necessary with the battery outfit. The battery would therefore save at $2 a ton, $5,474 per annum in coal alone.

The number of men in the station is now the same night and day and there would certainly be no increase in the labor item, whereas it is probable that one man on each shift might be dispensed with if the plant were reduced by the battery in which case there would be another saving of $1,200 per annum. The battery would also save water, oil, waste, etc., and there would be minor advantages such as more constant potential on the line; less annoyance from circuit breakers; no fear of sudden demands on the generating apparatus, and the disagreeable possibilities incident thereto.

In the accompanying tables some figures are tabulated for the purpose of comparing four different layouts to meet the requirements of the railway system referred to in Fig. 1.

I have assumed $100 per kilowatt as the cost of complete station apparatus without batteries. This figure might have seemed high a year ago, but in view of the rising prices of such material I think it is only conservative.

(Mr. Lloyd here referred to the South Side work noted in The Electrical Engineer last week.)

It might appear at first thought that a battery of sufficient capacity to insure a full load for the generating units at all times, would save as much fuel as a battery large enough to level off the 24-hour service, but it is very difficult to follow the power requirements from hour to hour in such a way as to make ideal use of a battery, whereas with a "large" battery it would be possible for the ordinary station engineer to adjust his load so as to operate all of his apparatus to the best advantage all the time.

I have carefully analyzed the figures in Mr. Conant's very interesting paper above referred to, and am compelled to differ from him at some points, and refer to them in order to meet in advance any criticism of my paper which may be based on his tables. In the first place he assumes that his standard station can be worked all the year round with a load factor of 33⅓ per cent., which is entirely too high; 20 per cent. or 25 per cent. would be more normal. I suspect that Mr. Conant's load factors have been obtained by indicator cards instead of wattmeters. In Mr. Conant's table none of the stations show a better figure for coal than 3 pounds per kilowatt hour, while his standard station is put down for 2.2 pounds without any intimation of the process for attaining such a good result. The question as to how the cost of repairs and depreciation of the entire plant would be affected by a large battery is particularly debatable ground. Mr. Conant allows 2 per cent. for depreciation beyond the normal running repairs. He estimates the entire plant including buildings to last 50 years. His statement that the machinery now being installed will last much longer than that with which we have been familiar in the last decade has nothing to back it up except faith in the promises of the builders.

I propose to allow 10 per cent. per annum for repairs and depreciation, on the entire station apparatus, including batteries. I have not seen any boilers that are likely to last 50 years, and there is plenty of evidence that all the best engines and boilers in this class of service to-day will go to pieces in a life of from 10 to 20 years. The particularly hard usage to which most of them are subject is not only steadily wearing them out, but producing a state of constant danger and not infrequent accidents. I am sure this is becoming well understood among railway men, and some of the best managers are writing off to depreciation 10 per cent. per annum. Moreover who can say that improvements will not be made in the next 10 years as in the past, and that engines and boilers may not be out of date before they are used up?

It is of course well known that whatever the rate of depreciation may be without batteries, it will be lowered by giving the generating apparatus a constant load; my belief is therefore that the storage battery will not increase the rate of depreciation for the entire plant. If it can be shown that interest and depreciation for a plant of given load dimensions are practically equal with or without a large battery, it is evident that the great saving in fuel alone will determine the superiority of the battery system.

I have so far considered the battery only at the central generating station so that all the advantages due to locating it at proper points in the distribution system are additional arguments in its favor. In many cases the saving in copper may be greater than the sum invested in the battery, and the flexibility of the system improved in places where it would not pay to install sufficient copper to meet the irregular demands of travel.

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The reserve qualities of the storage battery are unique. It might be supposed that a mere reservoir which is quickly drained would be of little value compared to a lot of extra generating apparatus standing idle, but experience is demonstrating every day in existing plants, that the reserve which is needed most is the reserve which is only ready for emergencies, but actually alive to any demand without the direction of a human mind.

Most of what has been said of the storage battery as applied to the power station illustrated by the curves in Fig. 1, is true of its application to railway power stations in general. The use of water power introduces a factor in the problem more variable than fuel, and I shall not attempt the discussion of it. Alternating currents lend themselves readily to the development of storage battery applications on account of the mutually helpful combination of battery and rotary at sub-stations. Up to the present time, each of the large batteries installed for railway work has been obliged to meet different conditions and requirements, but they are all serving their respective purposes well, and showing many different fields of usefulness. I shall not refer to these plants, because Mr. Appleton in a recent lecture to the New York Electrical Society has ably described those of most importance.[1]

Most of us feel that the electric railway and electric lighting interests are destined to get into closer relations, and the generating station of the future may be required to furnish all the electricity used within large areas for every purpose.

Coming finally to a problem which has been the subject of some newspaper discussion of late, I trust you will pardon me for treating of work with which I have no connection. Electricity has so many advantages over any other medium for transmission and storage of energy, that I assume its use to be firmly established and cannot conceive of any lasting rivalry by the other contestants now in the same fields. Further than this without saying anything for or against monopolies, I believe that all the energy supplied by means of electric currents to consumers of every nature in the Greater New York should radiate from two or three central stations, and that these should be electrically tied together. The sub-stations would naturally consist of rotaries and storage batteries. It may not be possible to lay out each sub-station so that the rotaries would run at a constant load for 24 hours a day, but it seems to me quite probable that such an arrangement would eventually be reached and this would of course give the generating stations a constant load.

At the present time the load curves of the electric railways are very uncertain, and peaks are likely to occur at almost any time of day, while the addition of the peak due to electric lighting in the early evening would not add in large proportion to the railway peak, but electric lighting is capable of more general application and it is possible that within a few years the distribution in the Borough of Manhattan may reach from three to five hundred thousand kilowatts at the highest part of the lighting curve, which will probably be as great as the railway load when the elevated railway and the underground rapid transit are included. These peaks will often occur at the same time of day, and so there is no possiblity of improving the load factor of either system by splicing the two together. It follows therefore that what is true of the relation of a storage battery to the economy of the generating station for power or light separately will be true of the resultant of their combination.

The railway and light people recognize the importance of levelling up some portions of their load curves, but I estimate that the greatest saving is to be obtained by operating for a constant load 24 hours per day. However high would be the economy of such large stations I am sure it would be higher with large batteries than without. Certainly the economy of the Boston pumping station as to fuel consumption should be surpassed. It must not be assumed that a high load factor for the system is an advantage. It is all right for the generating plant and for the copper feeders, but the kilowatt hours that bring in the most money, may spoil the looks of the load diagrams and kill the load factor. What is required to earn dividends is a profitable load factor outside of the stations, whether high or low, and the highest possible load factor at the dynamo terminals. The large storage battery meets these two requirements perfectly. A load factor of 100 per cent. may be maintained at the dynamo and current may be sold to the consumer regardless of the time of day.

With a million kilowatts in view for the Borough of Manhattan it would be necessary to generate an approximately constant force of 300,000 kilowatts.

A million kilowatts in station plant without the battery factor would cost $100,000,000.

The same capacity including the proportion of battery now deemed advantageous by some of the engineers in touch with these problems would be divided as to cost into $70,000,000 of generating plant and $30,000,000 of battery plant.

Finally the same capacity if divided in the proportions which seem to me most productive for the investment would cost $30,000,000 in generating plant and $70,000,000 in battery.

This is quite a large battery plant, and as there would be more than two parts battery to one part generator, I am fearful of the jealousy which such a reversal of engineering practice would create.

In conclusion I wish to state that nothing in this paper should be regarded as emanating officially or unofficially from the company with which I am connected.

A number of curves were presented showing a number of railway power curves with and without batteries. If they do not indicate attainment of perfect results by the battery, it is not because perfect regulation is impossible, but because the engineer is well pleased with what he has, and does not strive for greater refinement.

DISCUSSION.

The main points considered were the proportion of battery to engine capacity and also the question of depreciation.

Mr. Hill spoke of a plant installed in which the battery plant was greatly in excess of the engine capacity, so much so that two complete battery plants were installed, each one of which was able to carry the load on the plant for 15 hours. As a matter of fact, they carry the load for two and a half days each in the summer and one and a half days in winter. By this means one battery is being charged while the other is discharging. This keeps the load on the engine constant and at the point of maximum economy. The plant was put in four years ago and in all this time not a cent over $5.00 has been spent for the battery. The difference in cost at the beginning was not over $1,000, against the battery and this was returned the first year in saving of coal. It was estimated that the coal consumption under ordinary conditions would be in the neighborhood of 300 to 450 tons per annum; with the present arrangement it was only 118 tons per annum. This included all heating, power, light, pumps (electric), etc. The batteries are now in the best possible condition, due in part to the careful attention they have received.

Mr. Mailloux seconded the stress laid on the importance of the preponderance of the storage battery to engine capacity put forth in Mr. Lloyd's paper. He thought that it would be interesting to get the saving in different combinations of storage batteries and engines. He also thought that the depreciation considered was too low. He believed that 10 per cent. was a good figure and would be less under favorable conditions. He also took up the question as to whether the fluctuations disappeared very largely in stations where the load was very great, but did not think they did, although they were perhaps of shorter duration. Sometimes as much as 30 or 40 per cent. of the load.

Later he compared the rate of depreciation of Continental storage batteries with that in this country. As low as 4 per cent. has been given in Berlin, but this was under unusual conditions. One must consider the method of use in fixing the depreciation.

He also discussed difference in economy of engines under variable loads and constant loads and noted a previous paper that had been read on the subject where an engine which had been designed to give a high efficiency under a large variation in the constant load and when put on a variable load of the same variation lost as much as 33 per cent., in comparison. He said that in the case where the engine was not so designed the difference would be still greater.

Mr. Birdsall spoke of the use of batteries as pressure and load equalizers and the good results obtained by them. He also touched upon the practice of the lighting companies to-day of using a battery at times of light load to take current and giving it back at periods of heavy load, in this way approaching somewhat to gas practice of storing the gas during periods of light load and getting it back when needed, thus getting rid of the troublesome question of two rate meters and the attendant difficulties. He also referred to the great difference between engine capacity and load as shown in the first figure of Mr. Lloyd's paper and said that one reason for it was that the engineers of the

[1] The Elec. Eng., Feb. 2, 9 and 16, 1899.

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plants like to have an easy time and to have as many engines as possible running to insure this.

Mr. Lloyd, in answer to several questions, brought out the following points. The very important difference between depreciation of batteries and depreciation of machinery, was that when machinery depreciated at the end of a certain period the same would probably be out of date and the entire plant renewed. With batteries on the other hand when it became necessary to replace any of the plates you would get the benefit of the most modern practice and thus at the end of a certain time you would have a modern battery.

Then also in considering the depreciation of the plant as a whole the addition of batteries should not increase the depreciation a particle because of the immediate reduction in the depreciation of the machinery and auxiliaries due to their being relieved from the heavy fluctuations that cause so much damage by the crystallization that sets in under such conditions and which are the cause of so many disastrous accidents every year.

Trustedt Multiphase Apparatus for Separating Magnetic Materials.

THE apparatus for the separation of magnetic materials, illustrated herewith and recently patented by O. A. P. Trustedt, of Stockholm, Sweden, is claimed to effect a good separation of magnetic particles by causing them to tumble over. The pulverized material falls on or past one side of a non-magnetic material on the other side of which is placed a series of electromagnetic poles the windings of which are connected to the different coils of a generator for multiphase alternating currents in such a manner that the magnetic field of force wanders in a certain direction in the same way as in the well-known multiphase electric motors. The electromagnet system is stationary, as well as the cover; but the magnetic particles in trying to follow the wandering magnetic field will jump or tumble over in the same way as they would do if all the magnets were excited by currents of the same phase, but the system of electromagnets was moving.

In the drawings, Fig. 1, is a vertical sectional view of a separator, showing the connections with the electric generator; and

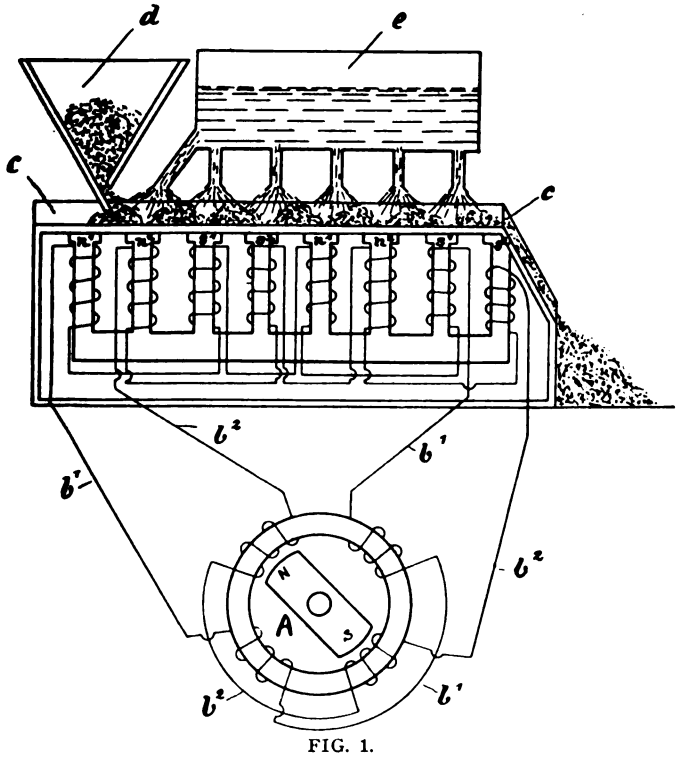

FIG. 1.

Fig. 2 is a sectional view in a plane at right angles to the view in Fig. 1.

A represents a generator for alternating currents, the armature of which is provided with two windings b' b², placed ninety degrees apart in the well-known manner, so that alternating currents whose phase is about ninety degrees different are generated. One winding, b', is connected to the first, fifth, etc., poles n' in the row of electromagnet poles in the separator and connected in the reverse direction to the third, seventh, etc., poles s' in the same row, so that the poles n' receive opposite polarity to the poles s'. The other winding, b², of the two-phase generator A is in the same way connected, so that the current in the same energizes the even numbered magnet pole in the said row, so that

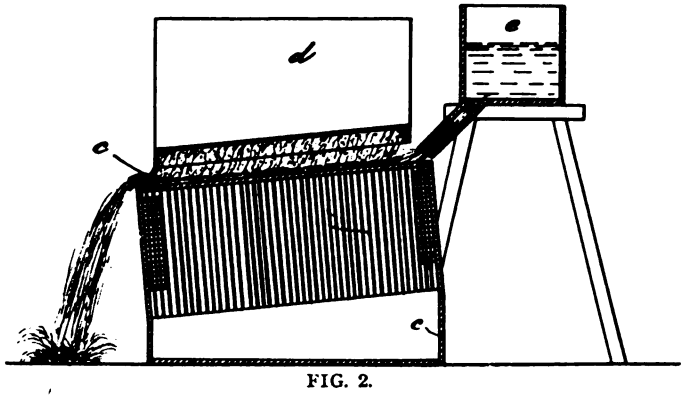

FIG. 2.

every alternate one of the poles n² receives opposite polarity to the others, s². The result of this connection will be that the magnetic field of force will wander in a certain direction from pole to pole when currents are generated in the generator. On the faces of the poles is placed a non-magnetic cover c, preferably laid directly on to the faces. The cover may inclose all the magnets, as shown in the illustrations, the wires leading to the different magnets entering through this cover in a suitable manner.

The pulverized mixture of magnetic iron ore or other similar particles to be separated is fed out on the one end of the cover from a hopper d, so that the particles fall in the magnetic field of force. The generator A is rotated in such a direction that the magnetic field wanders from the left to the right. The magnetizable particles being acted upon by the magnetic field will then try to follow the lines of force; but as the north pole, for instance, wanders from the pole n' to n² from thence to s', etc., the magnetic particles will jump over from the pole n' to the pole n², and so on, following the magnetic field of force till at the other end of the cover they fall down over the edge. From a vat e water may be forced over the wandering particles in a direction preferably crossing that in which the field of force and the magnetic particles move. The water will then wash away the unmagnetic particles, so that they fall on another side. Instead of water a current of air may be used.

In order to facilitate the magnetic particles leaving the last pole, the last edge of it is cut off and the cover made sloping.

The pulverized mass may be mixed with water and in a stream led over or past the magnetic field, which moves in a direction preferably crossing that in which the stream moves. The magnetized particles will cling to the field and by its moving be carried outside the stream, while the non-magnetic particles will follow the stream.

It should be unnecessary to mention that to avoid the heating of the magnets their cores would be well laminated and of soft iron, as is used in alternating current electromagnets generally.

The dimensions of the magnet poles, their number, and the frequency of the alternating current will depend upon each other and the material that is to be separated.

Instead of two-phase currents, as have been described, three or more phase currents may be used in a similar manner.

Exhibition of Electrical Appliances in Brussels.

Under date of January 25, Consul Roosevelt, of Brussels, says: At a meeting held January 20 by the Belgian Society of Electricians (M. Emile Closset, No. 26 rue St. Jean, Brussels, president), it was decided to open an exposition of all sorts of electrical appliances applicable to domestic uses. The exposition will be held next May in the new post and telegraph office, Place de la Monnaie, Brussels. It is the purpose of the society to make a complete exhibition of the various uses to which electricity may be applied in the household. Besides appliances for illuminating purposes, there will also be exhibited small motors for operating dumb waiters, cleaning and polishing shoes, heating kitchens, cooking stoves, bathrooms and bath tubs, electric

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teapots, sad irons, domestic telephones—in fact, all appliances operated by electricity, with a view to the total suppression of the use of coal for domestic purposes.

ELECTRIC LIGHTING.

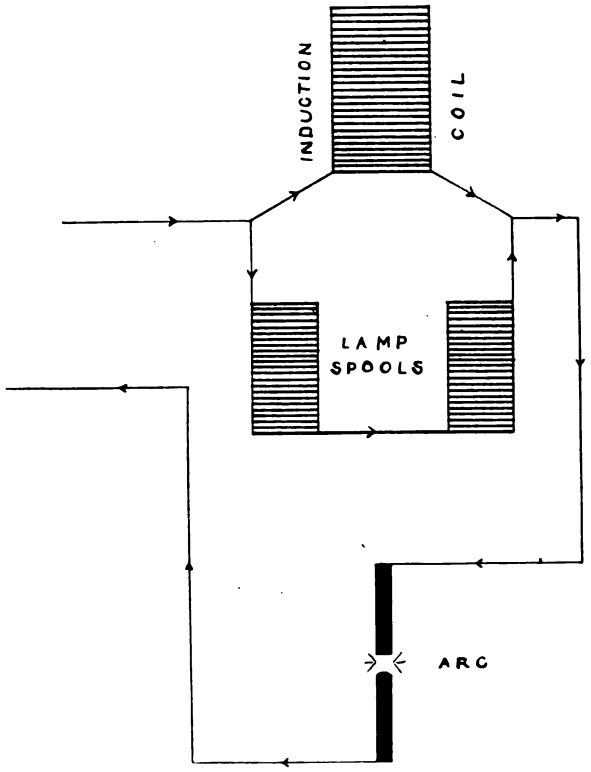
A 95 Volt Arc.

BY ALTON D. ADAMS.

GASES confined with the enclosed arc raise its possible voltage far above the old standard of 45 volts for the open arc. An adjustment giving about 78 volts at the arc has been quite generally adopted for enclosed lamps, owing to the necessity for a large resistance in series with the arc to steady its action, but the highest pressure permissible at the enclosed arc is certainly much beyond this figure.

When adjustment is so made that an enclosed arc burns at much above 78 volts, from 110-volt mains, with only dead resistance in circuit, the arc is very unstable and the light is unsatisfactory.

As a 78-volt arc burning on 110-volt mains involves a loss in



NEW FORM OF ARC LAMP.

resistance of (110 — 78) ÷ 110 = .291 or 29.1 per cent. of the total energy drawn from the line, any decided increase of the volts at the arc, with satisfactory results, will mean a like reduction in the cost of energy for arc lamps from constant pressure mains.

In view of the above, an arc lamp, to which the writer's attention has recently been called, is of special interest. This new arc lamp has an induction coil connected in shunt with its regulating spools, and this combination of induction coil and spools in series with the arc, all as shown in the figure. Every tendency to change in pressure and current at the arc is opposed by the inductive action of the coil, and so to even a greater extent is any change of current of the lamp spools. The net result of reactions between the induction coil lamp spools and arc, is that a much larger per cent. of the line pressure is available at the arc, which in this lamp regularly burns at 95 volts. A number of these lamps now in use give a very steady white light and suffer nothing by comparison with the best lamps burning with only 78 volts at the arc. A high scientific authority has reported a gain in efficiency of 11 per cent. for watts actually expended in this 95-volt arc, over that of the 78-volt arc, and this result would be expected from the greater area of incandescence in the longer arc.

The loss of energy taken from the mains with the 95-volt arc is only (110 — 95) ÷ 110 = .113 or 11.3 per cent. of the total energy, as against 29.1 per cent. with the 78-volt arc, which shows a net saving in energy of 29.1 — 11.3 = 17.8 per cent. of the total.

To compare the light given by the 78 and the 95-volt arc, each drawing the same power from the mains, compare first the relative energy consumed in the two arcs which is found from 95 ÷ 78 = 1.217, showing that the 95-volt arc uses 21.7 per cent. more of the available energy than the other. Now, it was found on test that the 95-volt arc developed 128 mean spherical candle power with 398 watts at the arc, or at the rate of 128 ÷ 398 = .32 candle power per watt, while the 78-volt arc developed 91.3 mean spherical candle power with 322 watts at the arc, or at the rate of 91.3 ÷ 322 = .28 candle power per watt, so that the light produced per watt expended is .32 ÷ .28 = 1.14 or 114 per cent. as great in the 95-volt as in the 78-volt arc. Since the 95-volt arc uses 21.7 per cent. more of the total power from the mains than the 78-volt, and shows an increase of 14 per cent. in light for each watt used, the total increase in light with the same watts from mains for each lamp will be (1.21 × 1.14) — 1. = .38 or 38 per cent. more light from the 95-volt than from the 78-volt arc.

It may be said that the amount of light given by the ordinary enclosed arc is ample for the limited spaces in which they are often used, and this is no doubt true, but in large spaces the greater volume of light, without increased cost of power should make the new lamp valuable.

As the average user of arc lamps will be much more interested in a proportionate reduction in his power bills than in a 38 per cent. increase in amount of light, the 95-volt arc will be at a great advantage, if adjusted to make its saving in power used for a lamp of the usual strength.

Since the 95-volt arc gives 38 per cent. more light than that of 78 volts, to give the same light at a proportionate saving, the power used should be only 1 ÷ 1.38 = .72 or 72 per cent. of the power required by the 78-volt arc. To show the amount of this saving in a year of three thousand hours, consider the 78-volt arc taking 452 watts per the following test: The watt hours for this lamp per year will be 452 × 3,000 = 1,356,000, which at ten cents per thousand watt hours amounts to the sum of $135.60. A lamp requiring but 72 per cent. of above watt hours would save per year (100 — 72) 135.6 equal to 37.96 dollars, or more than the value of a lamp. It is to be hoped that this reduction in energy per lamp may be effected. Below are given the results from test above mentioned:

	Long Arc.	Short Arc.
Volts at main	110.	110.
Volts at arc	95.3	78.1
Amperes	4.19	4.12
Watts to lamp	461.	452.
Watts to arc	398.	322.
Mean spherical c. p.	128.	91.3
Watts per spherical c. p. lamp	3.59	4.96
Watts per spherical c. p. arc	3.11	3.50

Gain in efficiency in lamp.....27 per cent.
Gain in efficiency in arc.....11 per cent.

One spherical c. p. cost 27 per cent. less from the mains.

One watt taken by lamp will give 35 per cent. more light.

Clear inner and opal outer used. Some of above lamps are in use at the Continental Clothing House, and Boylston Cafe, Boston, Mass.

Lighting Deals in Indiana.

One of the latest big corporations is the Central Union Gas Company, with a capitalization of $60,000,000 half common and half 7 per cent. cumulative preferred stock, of which $10,000,000, half of each class, will be retained in the treasury for contingent and other needs. The company will be organized under the laws of the State of New Jersey to unite Central and Southern Indiana and Ohio companies, which control illuminating and natural gas and electric lighting companies, properties, plants, and franchises in such territory. Poor & Greenough are designated as the bankers of the company, and the depository and trustee

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is the Central Trust Company. The plan of union will be declared operative as soon as Poor & Greenough announce the control of the following gas companies: Indianapolis, Indiana Natural and Illuminating, Fort Wayne, Logansport and Wabash Valley, Lafayette, Ohio and Indiana, Dayton Tippecanoe City, Covington, New Weston, Piqua, Sidney, Troy, Springfield, Urbana, South Charleston, and Mount Sterling. The promoters of the plan are F. P. Olcott, Charles F. Dieterich, Anthony N. Brady, John Sloane, Samuel Thomas, E. C. Benedict and Samuel Thorne.

TELEPHONY AND TELEGRAPHY

F. M. Bell's Method of Sound Transmission.

WHAT appears to be an entirely novel method of sound transmission and one which is somewhat striking and of interest on account of the ingenious application of well-known electrical principles, is described in a recent patent issued to Frank Merrill Bell, of New York. Fig. 1 is a diagram showing the arrangement of the apparatus and circuits. Fig. 2 is an elevation of the sound receiver as it appears from the front, and Fig. 3 a plan view of the bearings of the balance beam, showing the situation of the diamond points d d.

A is the sound receiver, preferably constructed of wood and in the shape sectionally more or less closely following the configuration of the external human ear, for such a configuration yields the best results. The elevation of such a receiver is shown in Fig. 2. The receiver A is mounted opposite an orifice O in a suitable screen or case C and is supported upon the offset or cranked end of an arm B of a balance beam, the other arm of which, B', is provided with a suitable resistance R. The balance beam has a fulcrum or bearing F formed of a fine edge or of diamond points d d, the latter being shown in plan at Fig. 3.

The arms B B' are balanced when constructed, and the adjustment of balance to suit different rates of vibration is effected by means of the rider weights w w', borne by and sliding upon the arms B and B'.

Bearing with gentle friction upon the resistance piece R is a contact G, to which contact is attached by suitable conductors one terminal of an incandescent electric lamp L, the other terminal of the lamp being connected to a battery or other source of electricity E, the circuit being completed by connecting electrically the remaining pole of the battery to the arm B' of the balance beam at or near the fulcrum. It is obvious that the beam, therefore, should be of a conducting material or be provided with a conductor to establish a circuit in connection with the resistance R. It is non-essential and preferable that the lamp L should not be of great illuminating power nor be operated at a high voltage. A lamp operated at about eight volts with a current of two amperes yields good results. This low voltage admits of the resistance R being brought within practicable limits in a small compass. The light in this lamp varies from an orange to a red, being thereby more sensitive to the minute and rapid variations of the current under the control of the sound waves. The resistance of selenium is found to be more sensitive to the red and orange rays than to white light, and there is no lag in changes of luminosity as in the case of white light.

The resistance R is preferably constructed of platinum because the variations it introduces in the circuit of the electrical source E being effected by the sliding contact accruing from the motion of the balance beam under the influence of the sound waves impinging upon the receiver A, such a sliding contact is suitably provided by a platinum surface; but it is obvious the resistance R may be constructed of other material, such as carbon, it being understood that the resistance of the circuit is varied not by variation in pressure at the contact surfaces, but by variation of the length of the resistance R as introduced or removed from the circuit by the determined oscillations or movements of the balance beam, on which the resistance is borne.

The operation of the method so far as has been described is apparent. The receiver A, being set in motion by the sound waves impinging upon it, imparts an up-and-down vibratory motion to the balance beam, which motion becomes that of the resistance R. Variation of this resistance produces variation in the light of the lamp L, and the variation of this light following a high mathematical power of the current strength is very marked. Also it is obvious that the variation of this light is caused by and follows the variations of its prime source—namely, that of the electric current as regulated and controlled by the sound waves impinging upon the receiver A. In order to transform these variations of light into variations of electrical energy for transmission by a conductor circuit having inductive capacity, the following method is employed: P is a reflector, preferably of parabolic section, because such configuration permits of uniform distribution of the light rays, and in front of this reflector is placed a plate of selenium S or of similar substance, the electrical resistance of which plate will vary according to the intensity of the light falling upon its surface. It is obvious that other forms of a selenium or like resistance might be employed; but it is better to use a plate approximately of the dimensions of the opening of the reflector as affording a maximum surface actuated uniformly by the light rays. To this selenium plate, along one of its edges, is attached a suitable permanent contact, which is put into connections with one pole of a battery Y, the other pole of the battery being grounded. At the opposite edge of the

Fig. 1.

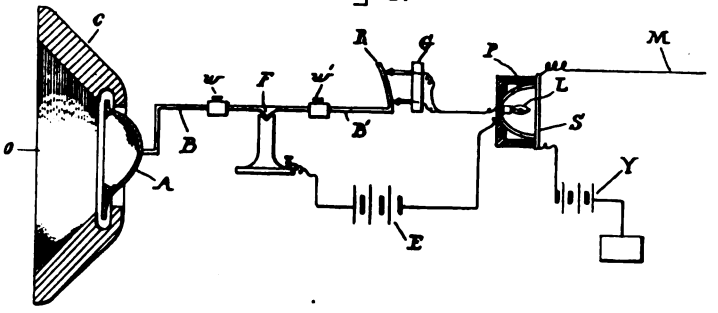


Fig. 2.

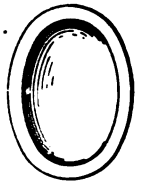
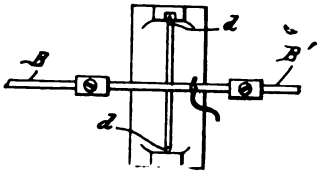


Fig. 3.



BELL'S METHOD OF SOUND TRANSMISSION.

plate a second similar contact is put into connection with the line or cable M, the distant end of which is grounded through a telephonic receiver of suitable construction. Variations in the resistance of the selenium plate caused by variations in the light of the lamp L are thus transmitted to the line or cable conductor. When the beam B B' is balanced to a note—D, for example—and the word "hello" is spoken to the receiver, the arm R will vibrate in a space equal to five-sixteenths of an inch and will cause the light to fluctuate so that it is very perceptible to the eye. To adjust the beam B B' to a certain note—D, for example—a D-fork is held in front of the sound receiver and the weights w w' are moved until the same note is heard in the receiver.

Although an electrical means of producing light and the means of varying its prime source of production has been described, the inventor does not limit himself to this means of producing light, as it is apparent that the invention may be extended to other means of producing light. For instance, an extension of the arm B' of the balance beam may be caused to bear upon a diaphragm set in the walls of a chamber containing an illuminating gas under a certain pressure, the variations in which pressure caused by the motion of the beam as produced by the sound waves will be communicated to a light produced by combustion of the gas in a suitable and so-called "sensitive" burner.

ROCHESTER, N. Y.—The Home Telephone Company, of Rochester, has been incorporated with a capital of $150,000 to operate a telephone system in Rochester and elsewhere in Monroe County. The directors are Frederick Cooke, Thomas W. Finucane, George W. Archer, Albrecht Vogt, H. Wheeler Davis, Gustave Erbe, George R. Fuller, Jacob Gerling, J. Foster Warner, Edward W. Peck, Horace C. Brewster, Eugene H. Satterlee, Willard B. Spader, V. Moreau Smith and Ezra M. Higgins, of Rochester.

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MAX LOEWENTHAL, Assoc. Editor.

A. C. SHAW, Secy. and Business Manager.

CHICAGO OFFICE, - - - - - - 1531 Monadnock Block.
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Vol. XXVII. NEW YORK, FEBRUARY 23, 1899. No. 564.

The Utilization of Water Power in the Paper and Pulp Industries.

IT was with a feeling of gratification that we recorded in our columns exactly one year ago the papers read and topics discussed at the annual meeting of the American Paper and Pulp Association. A number of them dealt with the employment of electricity in paper and pulp mills, in which nearly 1,000,000 h. p. is used in the United States and Canada, and showed how well adapted the induction motor is for the various purposes of such mills. Mr. Charles F. Scott at that time, in his admirable paper entitled "Electricity in Paper Making," cited in support of his arguments in favor of the electric current a number of large plants where numerous motors have been installed and are giving entire satisfaction, besides effecting a decided economy. Dr. Louis Bell strongly urged the advisability of locating mills near waterfalls and at points favorably situated with respect to cheap raw material and easy shipment of product. That the arguments brought forward at that time appealed strongly to the owners of mills and that they did not heed the warning of the late Dr. Emery, who told them that "for all ordinary purposes electricity is a luxury," may be judged from the papers read at this year's convention of the Association, held last week at the Waldorf-Astoria in this city. The members seem to have gone back to elementary but highly essential considerations, and took up for discussion such questions as the conservation of water power, topography of the territory through which the waters flow, as well as the history, utilization and storage of water powers. And this tendency of giving such prominence to these questions and the utilization of water power for the generation of electricity becomes of great significance to the electrical engineer, when he considers the fact that the paper and pulp art ranks about seventh among the manufacturing industries of this country. It opens up great possibilities for the employment of the electric current for numerous uses and reiterates the necessity for the electrical engineer to become acquainted with the laws and practice of hydraulic engineering. Many important and difficult questions have to be considered and numerous intricate problems solved in the most economical employment of various classes of water powers. Electric generators and motors, water wheels, governors, pipe and power house construction all have received considerable attention. In fact, to such an extent have they been perfected that in the Cumberland Mills, for example, an efficiency of 77 per cent. is obtained—that is, for every 100 h. p. mechanical output of the turbines, the motors deliver 77 h. p. to the machinery at the paper mills.

But it appears that the difficulties presented by the hydraulic end of enterprises have not received the same successful consideration as the above mentioned apparatus, and have, there, not been satisfactorily solved. To prove this we need only refer to the difficulties experienced of late at the Lachine Rapids plant with "frazil" ice and the trouble experienced with ice at Niagara, both of which are described in this issue. It does seem as if precautions could be taken to prevent such interference with the continuous operation of electric plants, and these troubles emphasize the fact that hydraulic engineering can no longer be excluded from the scope of a complete electrical engineering education, any more than civil and mechanical engineering.

In considering the question of the advisability of the National Government investigating water conservation, Mr. F. H. Newell stated that, with the exception of a few notable cases, the water powers now used have not been developed to their complete capacity, concluding his address with the hopeful advice that, "although water powers may, and perhaps will, be developed manifold, yet each individual case must be considered on its own merits and with a clear appreciation of all of the difficulties and dangers, as well as of the possible benefits.' The question of "Conservation of Water Power Abroad" was ably discussed by Mr. L. F. Vernon-Harcourt, and an interesting paper on "United States Topographical Maps the Basis of the Development of Water Power" was read by Mr. H. M. Wilson, who ably voiced the sentiments of many when he said: "Imagine, if you can, but ten years ago, a gathering such as this of the manufacturers of so humble a commodity as paper, listening with absorbed interest to essays by specialists on the water resources, the forests and topography of the United States." Yes, indeed, it must have been difficult to realize that such an intimate relation could exist as has been developed by the practical engineer under the fostering management of aggregated capital. We would suggest a similar annual meeting by the American Institute of Electrical Engineers, wholly devoted to water power utilization.

"Don't Travel, Telephone."

THERE is nothing better in advertising than a good "catch phrase," summing up the virtues or the advantages of the article recommended. The above headline has done yeoman service in this part of the world for the New York Telephone Company, and never did it seem more pat and fitting than during the past week of blizzard weather. A slight variation might have been in order, such as "Can't" instead of "Don't," but the injunction to stay at home was a mighty pertinent piece of wisdom. We have met during the past ten days a large number of suburbanites and out-of-town folks who were doing their best to become reconciled to the unexpected and involuntary enjoyment of the pleasures of a brilliant New York season, and their regrets at inability to break the blockade sounded a bit hollow; but for most people the risks of travel were so serious that where possible they were avoided. Hence the telegraph and telephone were availed of to an extraordinary degree, and we doubt if ever before in New York City so much of the real business of life depended on the telephone service.

Under these circumstances, we cannot but congratulate the telephone management of New York and Brooklyn alike, most heartily upon the way in which they met the emergency, and on the wonderfully excellent quality of the service they gave. Our inquiries have elicited from the company many details of the work, but one's own experience is the best evidence, and we can speak of personal results, both at home and in the office, in using the telephone. The only delays were those due to the very congestion of the enormous amount of business thrown on the system, and we think that every gentleman who used the telephone yielded a swift assent to the pleading, tired, little voice of "Central," asking for patience. Just how the girls stood the strain so well we do not know, but it probably was the fact that all possible care was taken by the management to ease the strain on them. What that strain was it was easy to ascertain simply by watching the long lines of waiting people at the pay stations, at the hotel booths, and in the large apartment houses. With foresight and liberality, the New York Telephone Company provided hotel accommodations for its operators close to each exchange, so that the force was ready and on duty with scarcely a break in the ranks, and thus a great emergency was finely faced.

To mention the mere fact that last Tuesday, when the effects of the storm were being felt severely, the telephone service

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5729 Sheet 9. CONDUCTOR NOMENCLATURE. B.

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The various parts of a conducting system have been given names which indicate the special function of that conductor in the distributing system shown on sheet 5279, sheet 10. A conductor leading from a generator to the switchboard or point of distribution is designated as a lead; the positive or negative lead according to which brush it is connected. The equalizing lead is the lead connected to the brush terminal, which also connects to the series winding, the other end of this lead connecting directly to the equalizer bus. The field connections are made through conductors called the field leads.

The bus is that common conductor to which the generators supply and from which the feeders receive current, or to a local conductor which is fed into and from which current is distributed.

A feeder is that conductor to which the main circuits are connected, and is supplied from the bus. A subsidiary feeder is where the feeder is tapped into one main, and passes further, and again supplies another main. The portion of the feeder lying between the two mains is called the subsidary feeder. A vertical feeder in a building is called a riser.

The main is the conductor from which all consumption circuits are taken. An equalizing or compensating main distributes current between two consumption districts for maintaining an equal loading on feeders. A service connects directly from a main to a house, or other specific consumption circuits.

The internal distribution for consumption circuits takes two general forms; the tree system and the closet or table method. The tree system comprises those methods which have the consumption circuits taken directly from a trunk main running through the location to be supplied. The closet system is where the feeder is terminated at any convenient point, and distribution circuits of limited capacity are branched from this centre of distribution. A loop branch is the distribution from a point using a continuous conductor from the tap to the termination of the circuit.

5729 Sheet 10 CONDUCTOR NOMENCLATURE. B.

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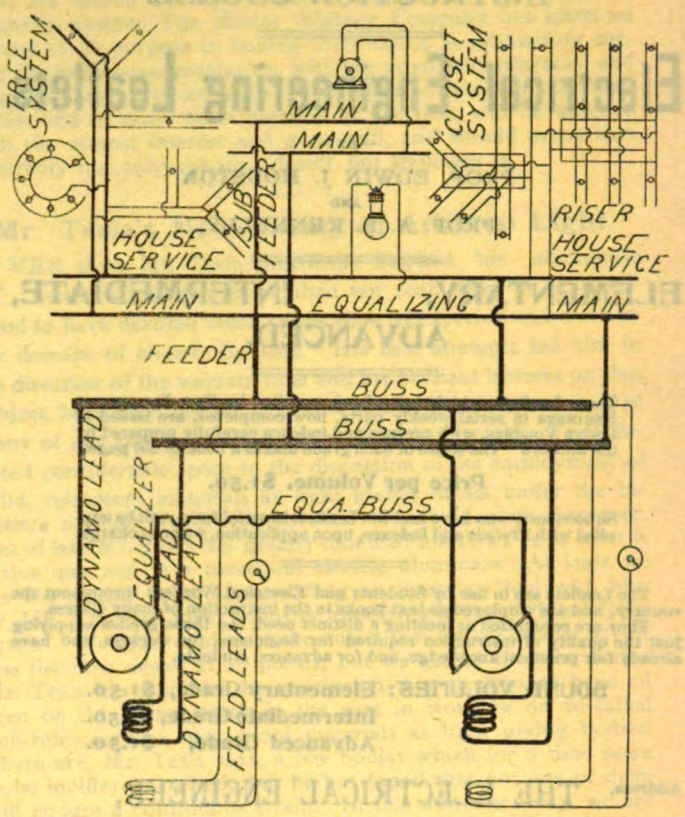

5737 Sheet 7. DATA FOR FIGURING STREET RAILWAY FEEDERS. B.

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The length of a railway feeder is the distance in feet from the switchboard to the first tap, to trolley wire, to this feeder, and if the maximum current is known, which flows through this wire, and the volts that will be allowable to lose with this current; then if the current in amperes, and the length of feeder in feet are multiplied together, and this result multiplied by eleven, and this product divided by the number of volts to be lost in transmission over this feeder, the result will be the size in circular mils of the copper wire to be used for this feeder.

Suppose that the wire was already fixed as to size, the volts lost, and the feeding distance also were fixed; then, in order to find how much current could be carried over this feeder, the size of the feeder in circular mils multiplied by the volts drop, and this result divided by eleven times the feeder's length will give the value in amperes of the maximum current flow for this feeder.

To find what the drop in volts would be in a given feeder of fixed length, current and size, multiply the current and length together and this product by eleven; divide this result by the diameter of the feeder in circular mils, and the result will be the volts drop or loss in pressure at the end of the feeder.

To find the resistance at any point over the section where the trolley wire is tapped to the feeder, say, with double track, there are two 2—0 trolley wires; these are in multiple with the feeder. Then the cross-section of conductor will be the sum of the circular mils of the conductor in multiple, which will be the circular mils of the feeder plus 2 x 133,000 = 266,000 c. m. Then as one mil foot of copper measures 11 ohms, this total number of circular mils, divided into 11 gives the resistance per foot of the conductor, multiplied by the feet to point of delivery of current from the trolley gives the resistance sought.

When there is a long distance between the tap from the feeder to both

5739 Sheet 2. ELECTROLYSIS OF BURIED CONDUCTORS FOR GROUND RETURN CURRENTS B.

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If method Sheet 1, does not increase the circulation of current on the water pipe, as the water pipe system is not necessarily a continuous conductor; and with poor joints local electrolysis will take place. Electrolysis requires a current flow to leave the buried surface in the presence of a liquid, and again sufficient potential to produce a disintegration of the metal surface acted on in the water. 1.5 volts is necessary to produce electrolysis of the water. Impurities and salts which can be broken down in their constituent parts, reduces the electromotive force of electrolysis underground. The products of decomposition stay adjacent to the surfaces acted on, and damped back by their resistance in the case of iron, the current of electricity producing them.

The tests for electrolysis are to determine the current flow and the points of departure from the buried surfaces. The rate at which the metal is decomposed per unit of current varies both with the condition of the surface acted on, and the impurities present in the water surrounding the surface undergoing electrolysis. With a new surface the rate for iron is much above 1.05 grammes of iron per ampere hour; but it falls to a value way below this after the products of electrolysis have obstructed the further action of the current directly on the surface. No constants can be given for these values, as they depend on the water and its impurities.

It has been assumed that the difference of potential between the water pipe and the rail indicated the amount of

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given was equal to that of four ordinary days, sums up the claim of the company on the gratitude of the citizens, and should go far to silence the absurd complaints heard now and again in the public prints. But the company will reap its own reward for there is more educating done as to the value of the telephone in one week, such as the last, than is furnished by a whole year of service on the average high plane of efficiency that the company maintains. After all, it is surprising that the process of education takes so long. Hardly a day passes when we do not have the opportunity to say to some one who had not thought of it: "Well, why don't you telephone?" Some day that habit of mind will have become both automatic and natural.

Travel During the Blizzard.

ONE rarely sees such a snowstorm as swept over New York City Saturday, Sunday and Monday week, or such complete paralysis of the means of transportation. All along the Atlantic coast, the steam railroads were at once tied up and stayed in bad shape for three or four days. Within the cities cut off from each other, conditions were not much better. Some of the trolley lines fared pretty well and kept up a service, although as late as Thursday night the writer plowed through two miles of snow on the track of one of them within New York City because no car was running on it at that time. The sub-trolley roads came off pretty badly and left their cars on the track during Monday, when at night it was a curious spectacle to see and flounder into cars standing idly in the darkness of the howling storm, but themselves brilliantly lighted and nicely warmed. The current was there all right, and the system was all right, but somehow the officials got overwhelmed. This is said without any intention of fault-finding. Perhaps closed conduits would have been better at such a time, but the suddenness of the drifts, which shifted position in huge volume every few minutes, made the problem of removing them quite difficult and apparently insuperable. It must be confessed that it would have been a great test to have seen a section of closed conduit road under the same conditions. Reports from Washington, where the snow seems to have been as bad as in New York, show that the sub-trolley roads there pulled through in great style, the snow king getting one in the solar plexus every time he tried to take possession of the lines. The question of keeping a road open is necessarily one of dealing promptly with the first flakes of snow, but whether flakes of such high frequency as those of last Monday yield to ordinary ohm laws, is a point that is possibly still left open.

As for the automobiles, they did admirably. While Mr. Condict, the electrical engineer of the cab service in New York, was snowbound in Philadelphia, because no steam engine could get him over the magnificent Pennsylvania system from Germantown, the New York Electrical Society met bravely at the cab house and saw the whole rolling stock of the company in active operation, literally coining money. Out of some eighty vehicles, perhaps half a dozen got laid up in mountain drifts, or twisted an axle, but the great majority were in incessant demand all through the storm, when to take out a horse was sheer cruelty. It is said that some of the drivers took a shovel along to help them when they struck a particularly nasty bit of snow, but it was most encouraging to see how those pneumatic tires did smooth a path along the blockaded streets. As with the telephone, the automobile made a new record for itself, in the Blizzard of '99.

Electricity and Irrigation.

ANYONE who has watched the recent development of California must have been impressed with the part that electricity has played in it, wherever water power has been obtainable. The importance of electricity is highly appreciated in that State, and we note the proposal of legislative measures to throw the strongest protection of the law around the transmission circuits. But the work that electricity can do in utilizing water power is equaled by that which it can do in furnishing water to regions now desert and barren. Some years ago we urged the availability of electricity for artesian well and pumping operations in arid territory, and are now glad to find that the Mount Whitney Power Co., of Visalia, Cal., is putting the plan into practice, while corresponding work for Arizona is also on the tapis. The Visalia scheme is to transmit current from a central water power plant to several sub-stations where artesian wells are driven and there operate pumps, etc., for a regular irrigation system. The Mount Whitney Company has given an earnest of its purpose in buying three 600 h. p. alternating current Westinghouse generators, with the auxiliary apparatus, and is going ahead with its plans. This effort to reclaim the alkali plains, and to make them blossom as the rose, will be watched with the utmost interest and good will, and should prove that electricity not only abhors a desert, but abolishes it.

Mr. Tesla's New Theory of Artificial Light.

EVER since Mr. Tesla practically finished his multiphase motor work, now more than ten years ago, he is understood to have devoted much of his time to experimental work in the domain of electric lighting. His first attempts led him in the direction of the vacuum tube and his brilliant lectures on that subject, both here and abroad, must still be fresh in the minds of many of our readers. But even in those lectures Mr. Tesla devoted considerable space to the discussion of the employment of solid, refractory materials as light giving media under the influence of high frequency currents. It would seem, however, that of late Mr. Tesla has greatly modified his views as to what is a sine qua non in a successful electric illuminant. At least we are led to this belief after reading an interview had with him by Mr. Charles Culver Johnson, appearing in the "Philadelphia Press." We must confess at the outset that we are unable to follow the interviewer at all points, but we gather in general that Mr. Tesla has come to the conclusion that electricians have all been on the wrong track in the past in working on so-called non-refractory or heat proof materials as light giving bodies. There are, Mr. Tesla says, a few bodies which for a time seem to be indifferent to heat, but he has found that not one of them will endure a continuous strain. In this new discovery, we are told, vibrations play a most important part, Mr. Tesla having succeeded in obtaining more perfect control of the more rapid vibrations of light waves. Carbon is not employed as the light giver. As to the nature of the force employed the interviewer quotes Mr. Tesla as saying that he "will form an electric circuit and then with a file reduce the thickness of the wire a sixteenth of an inch and double the force of the current." The details of Mr. Tesla's work in this direction are unfortunately lacking, but Mr. Tesla promises to prepare a paper on the subject, "which he will read presently to a few scientific friends." Failing full details the information thus far vouchsafed is insufficient to permit of much comment, but we are glad to know that we may so soon expect a promised advance in electric lighting. All such work as this, or, in older directions, such as that on the Nernst lamp, is worthy of fullest encouragement.

Electric Stairways.

ATTENTION was called lately to the inadequacy of the elevators at the big Opera House, in New York City, by the death of a lady who died from exhaustion in climbing the stairs to one of the upper circles of the auditorium. The elevators are so located and arranged that they only carry passengers up one or two stories, and the consequence is that every time the House is open thousands of its patrons have to climb long flights of stairs. Many of them suffer and all grumble. Some die.

It is said that the elevator service cannot be changed, or, if changed, that enormous expense would be involved. But that being so we can see no reason why the long flights should not be equipped with the electric traveling stairways that are now so rapidly coming into fashion with the dry goods stores and that handle hundreds of thousands of people, mostly women and children, in absolute safety and very cheaply. The current to run the mootrs could be taken from the lighting mains and the simplicity of the thing would familiarize it with the public instantaneously. The cost of installation would, we believe, be met by the increased demand for upper seats at a price not less than that of seats downstairs. In an office building, the elevators have made the upper floors more desirable at equal rents with the lower, and we believe that electric stairways would do much to make Opera spell profit in the same manner.

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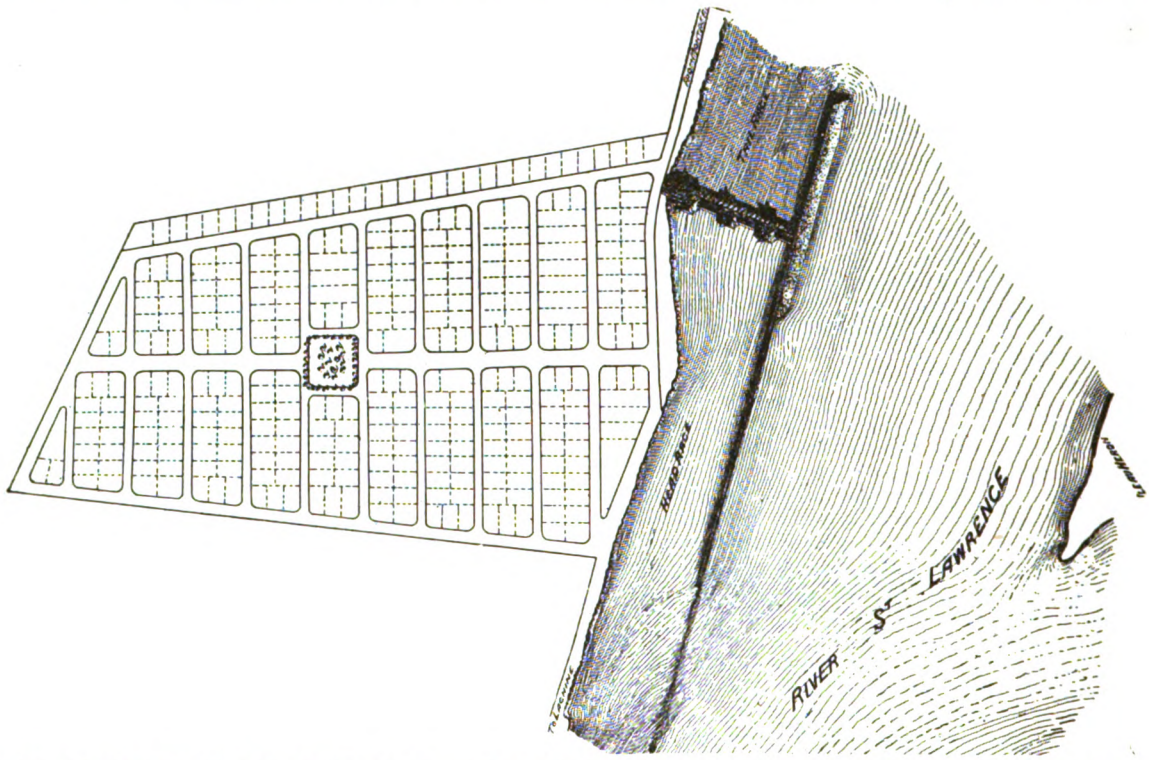
Frazil Ice in the Lachine Rapids.

WHEN it was proposed a few years ago to harness the waters of the St. Lawrence, where its flow is most turbulent and its power the greatest, namely, at the Lachine Rapids, near Montreal, the engineers knew well that one of the greatest obstacles which they had to overcome was the probable disturbing action of anchor and "frazil ice," the bugbear to all who have to do with water powers in Canada. This was pointed out in The Electrical Engineer in a descriptive article of the proposed installation on October 7, 1896, where it was also stated that the engineers had made a careful study of all the surroundings since



LOCATION OF POWER HOUSE, DAM, HEAD AND TAIL RACES AT LACHINE RAPIDS, NEAR MONTREAL, CANADA.

1875, determining the bed of the rapids, the velocity of the water and the records of the state of the river. It was thought at that time that a course had been adopted in constructing the dams and headrace which would be satisfactory and free from this trouble. This, however, seems not to have been borne out by recent experiences during the severe weather early last month, when the Lachine Rapids Land and Hydraulic Company had considerable difficulty in obtaining sufficient head to keep the plant in operation. The lighting companies subsidiary to the Lachine Rapids and Hydraulic Company, the Imperial and the Temple companies, says the "Canadian Engineer," had to start up their steam plant, and the Imperial borrowed a dynamo from the Royal Electric Company.

The two chief difficulties in the problem of maintaining the head are the sudden and very great fluctuations in the river level below the rapids, caused by ice jams in the river and the formation of frazil ice. It has been found that the changes in the river level at the city are not so important as was anticipated, but a great deal of trouble has been found through the formation of an ice dam on the rock bottom of the shallow stretches immediately below the tailrace. On the occasion referred to, the level of the water in the tailrace rose ten feet owing to this cause and for a time the head was reduced to three feet. The removal of the rock in the shallows below the tailrace will probably remedy this defect, and it becomes only a question of how much the company is prepared to expend in securing itself against similar occurrences.

The second difficulty, that caused by frazil, is as yet unsolved, and if the report is true that the company intends to install a steam plant in Montreal as an auxiliary, capable of running all the arc lights in the city, it would suggest that the final solution is believed by the company to be still remote.

The recent obstruction of the intake which reduced the level of the water in the headrace from nine to five feet was due to the existence of frazil. The construction of the intake, as will be seen in the illustration, is as follows: Between the pier head and shore are placed in a slanting line three rock-filled caissons, and along the upper side of these is stretched a boom 30 inches deep. A little lower down is a second boom, which is four feet deep. Between these two booms is maintained an open sheet of comparatively still water. These were constructed so that the frazil floating down the current would be stopped by the first boom and carried away by the current which sweeps along it. Should any get past this boom the clear space of quiet water was maintained for it to rise in, and the second boom constructed to catch it. A part of the construction dam has been left, which, though it does not come up to the surface, is so near it that pieces of ice catch in floating over it. This obstruction lessened the current sweeping the outer boom and also caused a large eddy. In this way the frazil was not carried off as it should have been. The snow also, which fell heavily at the time, drifted into the open space between the two booms, formed slush, and this getting under the boom rose again immediately and froze to the underside of the ice. Thus, between snow and frazil the intake became frozen solid from top to bottom over a considerable area. This had to be blasted out. To prevent a recurrence of the snow difficulty, a snow fence has been constructed across the ice below the intake. It is stated further that, to prevent the frazil coming in, a few feet will be removed from the top of the old construction dam so that ice may pass over it freely and the outer boom be continually washed by a swift current.

There can be very little doubt that if any solution of the difficulty can be reached, the engineering staff of the company will arrive at it. It has been established that frazil does not form in ice-covered water that is warmer than the open stretches, and frazil is only formed in water whose temperature is below freezing. The vast amount of the St. Lawrence which is kept open by the rapids and swift currents materially cools a large body of water, and this is especially true of the river at Lachine, where

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for a distance of about six miles above the company's works the river is almost entirely open. In these open rapids frazil is formed in great quantities, and it is yet to be shown that at the bottom of such an extensive stretch of rough open water there can be maintained a sufficient area of still water by which the turbines may be driven and from which the frazil coming down the river can be excluded. We trust success in solving this problem may yet be attained.

Winter Power Difficulties at Niagara.

THIS winter the ice at Niagara Falls has been more troublesome than at any time in the history of the power development. This has been especially true in the case of the service rendered by the canal of the Niagara Falls Hydraulic Power and Manufacturing Company and in the power station of the Niagara Falls Park & River Railway on the Canadian side, in which station the Canadian Niagara Power Company have two generators installed.

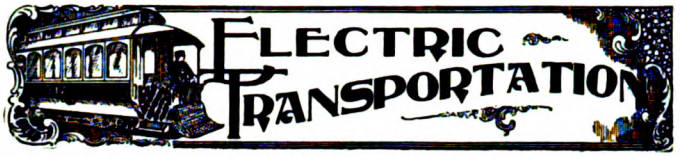
The severe weather caused great ice fields to form in Lake Erie and this ice was blown down the lake to the entrance of the Niagara River, where it was caught by the current and hurried toward the falls. In the river above the falls, great quantities of the ice lodged on reefs and bars, and had a tendency to divert the water from the New York shore toward the deeper channels of the centre. This naturally resulted in low water in the hydraulic canal, and especially was this result developed by the ice that gathered about the canal entrance. The ice became very troublesome, and the water was so lowered that ice in the canal basin became anchored to the bottom. On Sundays, when many of the mills are not operated, the severe weather froze the surface of the canal until quite a body of ice formed, which it was necessary to remove before the water could come down in sufficient quantities to operate the wheels. Men were set to work at the entrance of the canal blasting the ice to pieces with dynamite, and the same method was used down along the course of the waterway and in the basin. Several nights the work was continued, and the waste gates of the basin were opened in order that the ice might pass over the bank. The company's tug was also a great help in breaking the ice in the canal and driving it down to the basin. With the ice removed from the entrance of the canal the flow of water was sufficient for the mills, but all of them have been more or less troubled.

On the Canadian side similar conditions existed. There the ice gathered on the rocks and shores to such an extent that no water reached the power house inlet, or, at least, what did reach it on some days was devoted to the operation of the wheels for the Canadian Niagara Power Company, in order that their service might be the best the conditions would warrant. For this reason the Niagara Falls Park & River Railway has several times stopped operations for days at a time during the winter.

On the reefs and shallow places above the falls there are great fields of ice, and up in Lake Erie there is an immense quantity of ice which is likely to sweep down on Niagara any day the wind comes from the east. In the gorge just below the falls there is the greatest ice bridge and mountain Niagara has ever had, and with the ice that seems yet likely to come down the river, there is no telling what novel conditions may yet be developed in the power development at Niagara. None of the men connected with the Niagara plants remember a year when there have been such conditions in the Niagara water supply. On Friday afternoon the entire canal channel and basin had been cleared of ice, and the prospects were that the plants that had been shut down for three days would be able to start up.

One of the features of the trouble was the shutting off of the current for the operation of small motors throughout the city. This supply comes from the station of the Niagara Falls Hydraulic Power and Manufacturing Company. In the case of the "Daily Cataract" the press was forced to remain idle and the forms were sent to Buffalo to be printed. The "Gazette" had a wire hurriedly strung to a near-by planing mill, and there connected to the wires of the Buffalo and Niagara Falls Electric Light and Power Company, and by this means their presses were run. The "Daily Cataract" adopted the same course the next day.

GRAND CANYON, COLO., is to have nine gasoline automobiles running from Flagstaff, A. T., each driven by a 14 h. p. gasoline engine and seating 18 persons.



The Storage Battery Locomotive of the P. L. M. Railway, France.

WHILE a number of electric locomotives are operating on the steam railway tracks in the United States at the present time in regular commercial work, France is the only country in which serious attempt has been made to employ electric locomotives in this manner abroad. Our readers are already familiar with the experiments made with the Heilmann locomotive on

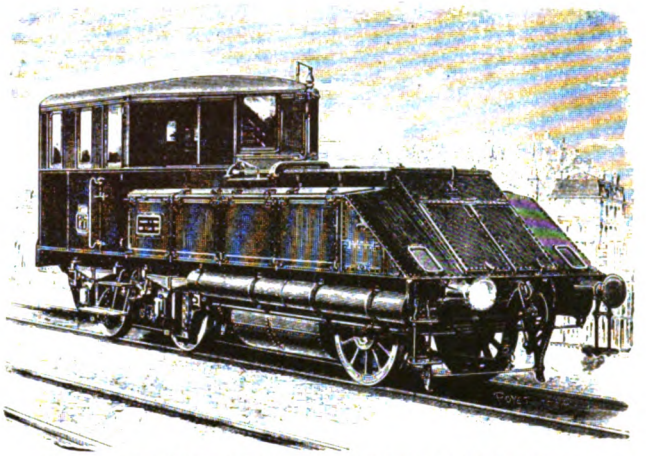


FIG. 1.—FRENCH STORAGE BATTERY LOCOMOTIVE.

the Northern Railway of France. A recent issue of "La Nature," however, contains a very interesting article on a storage battery locomotive of the Paris-Lyons-Mediterannée Railway of France. This locomotive was constructed under the direction of M. Baudry, chief engineer, and M. Auvert, engineer of the Central Service. The locomotive in question, illustrated in perspective in the engraving, Fig. 1, was built towards the end of 1897, and has been used experimentally since then on the line between Paris and Melun. The locomotive has three axles, two of which are drivers, and it has about one-half the power of an ordinary express locomotive; but it would suffice to double the number of driving axles to give it the normal power of the ordinary locomotive. This locomotive is followed by a tender carrying storage batteries, the hauling of which absorbs a considerable part of

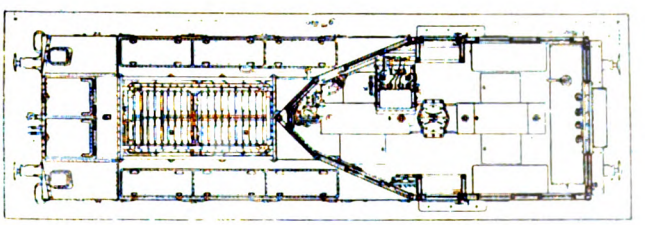


FIG. 2.—PLAN OF LOCOMOTIVE.

the power of the locomotive owing to its great weight; but it is evident that this tender would be replaced by a paying load if the electric current were carried by a special conductor such as a trolley or third rail.

The three pairs of wheels of the locomotive are all of the same diameter, that is, 1.1 meter. The front wheels are six meters distant from the rear drivers. The two latter are placed 2.2 meters apart on centres and are driven independently by motors.

The front compartment of the locomotive is depressed so as not to interfere with the view from the engineer's cab. This front compartment contains an air compressor operated by a small electric motor of five h. p. which furnishes compressed air for the Westinghouse brakes, for the whistle and for the regu-

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lating apparatus. The three other compartments, two situated at the right and one at the left, are one meter high and contain each nine cells of storage battery. These are connected in series and serve to excite the fields of the compressor motor and furnish the current necessary for the air compressors and for the electric lighting of the cab, etc. The cells may also be employed to run the locomotive itself at low speed. The middle compartment contains a large water rheostat controlling the large motors on the driving axles.

The current is furnished by two storage batteries of 96 cells each carried on the tender. The normal strength of current in regular operation is 700 amperes, being equivalent to 300 h. p. at a speed of 500 revolutions, equivalent to 103 kilometers per hour. Under these conditions, the difference of potential at the brushes is 360 volts. The capacity of the eighteen cells carried on the locomotive proper is 1,500 ampere hours. The plates of a cell represent a weight of 140 kilograms. The total weight of

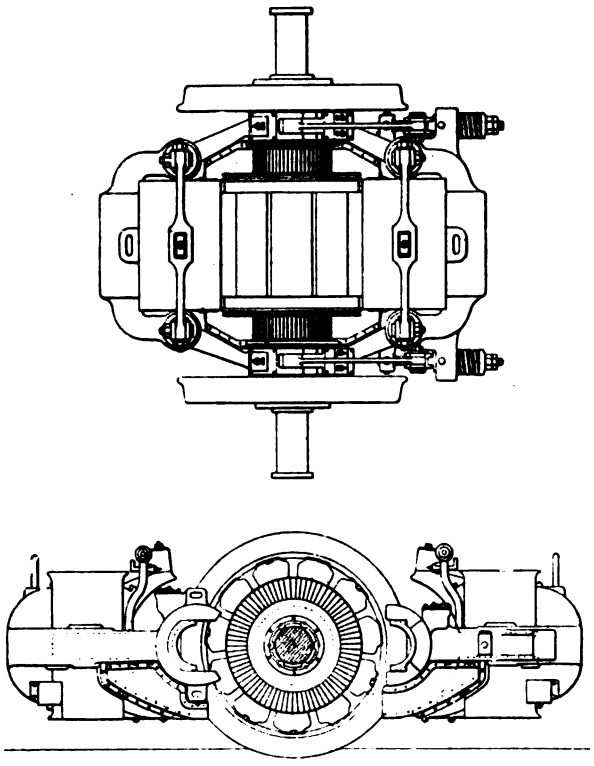

FIG. 8.—PLAN AND ELEVATION OF MOTOR.

the locomotive is 44,500 kilograms, 12,500 of which rest on the first leading wheels, and 16,000 kilograms on each of the two main drivers. The total weight of the tender is 45,800 kilograms. The storage batteries number 192 and are able to deliver 1,000 ampere hours at the rate of 500 amperes.

Fig. 3 represents the arrangements of the electric motors, the armatures of which are mounted directly upon the axles. The armatures are built on the Brown system, the conductors being enclosed in the iron of the armature. Their diameter is 0.690 and their length 0.540 m.

As regards the actual work done by this locomotive it may be stated that its first trip was made on the 26th of November, 1897, between Paris and Ville-neuve-St. Georges with only 48 storage cells in the tender. Since then it has made a number of trips between Paris and Brunoy with 48 cells; then between Paris and Melun first with 100 cells, and finally with its complete equipment of 192 cells. The maximum load hauled between Paris and Melun was 147 tons, including the tender on the locomotive at the speed of forty-five kilometers per hour. In lowering the load hauled to 100 tons the speed of 100 kilometers (62 miles) per hour was reached, corresponding to an effective power of 611 horse power.

MR. W. E. BAKER, well-known in electric railway circles and lately general superintendent of the Chicago Metropolitan Elevated, has been appointed chief electrical engineer, etc., of the Manhattan Elevated. He is a highly competent man for that responsible position.

Electrolysis Caused by Stray Railway Currents in Jersey City.[1]

BY A. A. KNUDSON.

BELLEVILLE AVENUE is a street in the country over a portion of which the trolley cars of the Union Traction Company run on their way from Rutherford to Arlington, N. J. There are no fire hydrants on this road, as is the case in cities, in connection with the pipes, which are convenient for making electrical tests. Therefore excavations were necessary. Two of them were made, one at the intersection of Belleville and Kearney avenues, near the reservoir, and the other at Elm street. The distance between the two excavations was about 2,000 feet on the Belleville road, for which distance the pipes and tracks occupy the street. A test was also made at a gate on pipe No. 1, located about 300 feet from the Elm street corner. After the mains had been uncovered and electrical connections made, voltmeter readings were taken to ascertain the difference of potential between the rails and pipes. For convenience of reference these are recorded in the following table. The cement covered main we designate as No. 1, and the others, to the right, facing the reservoir, as Nos. 2 and 3:

RECORDS OF TESTS MADE.

Jan. 5th, 1899. Time, 1 to 3 p. m. Weather mild.

No of Main.	1.	2.	3.
Distance from nearest rail.....	2 ft. 6 ins.	4 ft. 6 ins.	8 ft. 2 ins.
Size of main	36 ins.	36 ins.	20 ins.
Year when laid	1873	1862	1853
Max. d. of p. at Kearney ave., rails positive	5 volts	10 volts	10.2 volts
Max. d. of p. at Elm st.....	2.5 volts	2 volts	4.1 volts
Test Jan. 10, 12.30 p. m., Elm st.	....	....	15 volts
Max. d. of p. at gate, rails positive	6 volts	....	....

The table shows that stray currents of electricity are passing from the rails of this road into your mains at a voltage much too high, in view of other conditions of the case to be explained later, to consider them free from the destructive action of electrolysis. The range of maximum voltage is from 5 to 10.2 volts at Kearney avenue, and from 2 to 15 volts at Elm street, this latter high reading being discovered at a second test on the 10th instant on pipe No. 3. The rails, however, in all of these tests, were positive to the mains; consequently no damage is anticipated from electrolysis to the pipes in this street, and no signs of same were found at these excavations on any of the mains. The rails, however, show evidence of electrolysis to a marked degree at both openings, but more so at Kearney avenue, where their lower sides show considerable corrosion.

It will be understood that the point where damage is caused by electrolysis is where the current leaves the metal, or, in other words, tests positive to some other metal.

For the purpose of easy reference as to position of tracks, with mains, distances from same, etc., we submit Fig. 1, which shows the situation where the Kearney avenue excavation was made. At the Elm street corner the distances are about the same, with the exception that pipe No. 1 comes under rail B, instead of rail A, Nos. 2 and 3 further to the right and keeping about the same distance throughout.

In former experience it has been found that when a stray current passes from the rails of the road to water pipes it is very apt to find an exit at some other locality in the system in seeking another path of easy return to the dynamo. In our efforts to discover, if possible, such point of exit of the current in question we have consulted maps which show the line of the Union Traction Company's railway, the location of their power station, and the route of your water main. From a careful study of the same we came to the conclusion that the most probable point of exit in this case would be where the water mains cross the salt meadows on their way to Jersey City, for the following reasons:

First. The power station of this road is located at Rutherford, on the border of the salt meadows.

Second. The distance in a straight line from the water mains, which the current would take at a point near the shore of this station, is shorter by about two miles than the route of the

[1]Abstract of a report to Mr. A. Van Keuren, Chief Eng., Board of Street and Water Commissioners, Jersey City, N. J.

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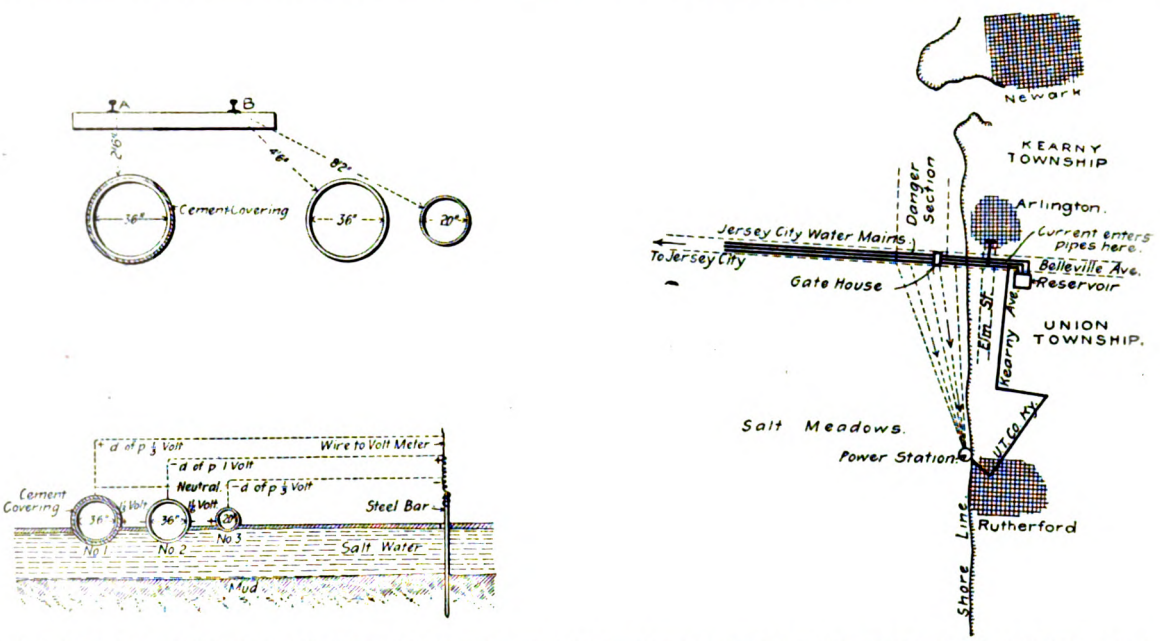
railway over the various roads through which it runs. This is shown by the use of a scale of miles.

Third. The salt water and mud of the marsh in which these mains are partly submerged offer a good conductor for the current to pass through them on to the aforesaid power station in a direct line. We therefore, with the assistance of your foreman, Mr. Carroll, made voltmeter tests at a point known as the gate house, about one-half mile from the shore proper, on the morning of the 10th instant, between the hours of 10 a. m. and noon, weather very cold.

In our attempt to intercept any current which may be flowing from the pipes at this point toward Rutherford we drove a steel bar down through the ice and water and well into the mud of the marsh. From its upper end we connected a wire and attached the distant end to the voltmeter. Electrical contact was then made to each pipe without difficulty and the voltmeter readings were taken.

As the results of our tests at this point show features of scientific interest as well as information of importance, we give them in Fig. 2, and also in Fig. 3. It will be seen that the two outside mains, Nos. 1 and 3, are positive to the steel bar at a difference of potential of one-third volt in both cases, while the condition of stray currents found by me in a recent investigation in the vicinity of the Brooklyn Bridge entrance, New York, where it was found that railway currents passed over the structure to New York, thence up the East Side, through underground pipes, etc., and recrossed through the river to the power station at Kent avenue, the difference between this case and yours being that your water mains represent the bridge and the salt meadows the iron piping and the East River.

It is probable that if a number of tests were made along the sides of these mains in the meadows the voltage would be found to vary, higher or lower, as the case may be; but we believe sufficient data have been discovered to determine existing conditions. The danger section, therefore, of your water mains, as we have endeavored to locate in this investigation and set forth in this report, is on the salt meadows, where the current leaves the pipes about two miles from where it enters, at Belleville avenue. Taking all things into consideration, therefore, the excessive escape of 10 volts maximum at Kearney avenue, and of 15 volts maximum at Elm street, and the passing out of this current on the meadows through an electrolyte, such as salt earth and salt water, thereby facilitating the action of electrolysis, is a condition which, if allowed to continue, will, in my



FIGS. 1, 2 AND 3.—DIAGRAMS SHOWING POSITION OF PIPES AND TRACTS OF COUNTRY NEAR JERSEY CITY, N. J.

middle pipe, No. 2, tests 1 volt negative to the bar or marsh, the outside mains, 1 and 3, testing neutral to each other.

Tests between the mains show that both Nos. 1 and 3 are positive to No. 2 with 1 1-5 and 1 1-6 volts, respectively, showing the current to be leaving the two outside mains and passing into No. 2.

While these tests show a comparatively low voltage from the outside pipes to the marsh, under conditions such as being buried under soil free from alkaline solutions or salts such as would prevail on a country road, no particular danger from electrolysis would be feared; but as the case stands, the presence of salt water, in which they lie continually, is an electrolyte which materially assists the action of electrolysis even at low voltage. Again, the case is more serious under these conditions when the higher voltage of 1 1-5 is considered found passing between the mains. The brick and cement coverings on pipe No. 1 would offer but little, if any, protection against electrolysis under these conditions. From these tests, therefore, that were made on the meadows, the indications are that much of this escaping current passing into your mains on Belleville avenue comes out from them on the meadows, but distributed for some distance along their length, probably for half a mile, as illustrated by Fig. 3. the arrows pointing in the direction the current takes in returning to the power station at Rutherford.

Mains Nos. 1 and 3, therefore, according to these tests and indications, would be the ones affected by electrolysis, while No. 2 would be practically free from same.

The results of this investigation show a striking analogy to a opinion, seriously shorten the life of these very important water mains.

In regard to the remedy I have consulted with the officers of the Union Traction Company with reference to making such changes that will reduce this escape of current into your mains, and they express their willingness to do whatever is necessary to obviate the trouble.

I do not think that this escape of current is due to any imperfect design of construction, as, generally speaking, the road is well built, much better than is found among the average trolley roads operating through and between small towns. It is provided with an insulated return conductor through its entire length, which many electric roads do not have. I have also seen the character of bond used for connecting electrically the ends of the rails, and they seem to be as good as any in the market, two being used, I am told, for each rail. Notwithstanding this, there is something wrong, and the railway people appear to be anxious to discover and rectify it for their own interests as well as yours.

The most effectual method for eliminating this current escape to your mains would be a removal of the rails from this portion of the street in which the mains are located. As this, however, may be impracticable, I would suggest that the company be allowed to make such changes to reduce the escape as they have in mind, such as putting in more frequent tap connections from their return wire to their rails (they now being over 1,000 feet apart), and examining and renewing such rail bonds, as well as cross bonds, as may be found imperfect. When this

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is done further tests should be made at Belleville avenue, as well as at the danger section on the meadows, to determine if the escaping currents have been checked and danger from electrolysis removed.

In referring to future tests on Belleville avenue these can be made without further excavations, as before the holes were covered in we took the precaution to make a good connection with insulated wires to one of the mains (No. 3), which was led up to a known point on the surface. This was done at both of the excavations, and as tests have been made at both places since covering it, the readings of the voltmeter showed the wires to be intact and ready for future use.

The instrument used in making these tests was a standard Weston high and low reading voltmeter, which had not been used since being recently standardized at the Weston factory, at Newark, and consequently was in perfect order.

A Long Electric Road for Michigan.

There is now every prospect that the proposed Lansing, Dexter & Ann Arbor electric road will be built and in running order within six months. W. W. Churchill of New York, and C. W. Register and O. A. Stranahan of Chicago, engineers of Westinghouse, Church, Kerr & Co., the well-known engineering and constructing concern, have gone over the line of the road to obtain an idea of the probable cost. Dr. R. J. Shank and C. A. Mapes of Lansing, Morris Topping of Plainfield, L. C. Chase of Dansville, and Thomas Birkett of Dexter, directors of the new road, met these gentlemen, and Wallace Franklin, the Michigan representative of the Westinghouse Company at Detroit. As a result, it is announced that arrangements are completed for the Westinghouse Company to finance the railroad company's bonds in the East and build the road in the time mentioned. It is expected that bonds to the amount of $1,175,000 will be issued. The Michigan directors, six in number, have subscribed $250,000 to build the road, operations to commence in about a month. Emerson McMillin was in the city and conferred with the parties interested.

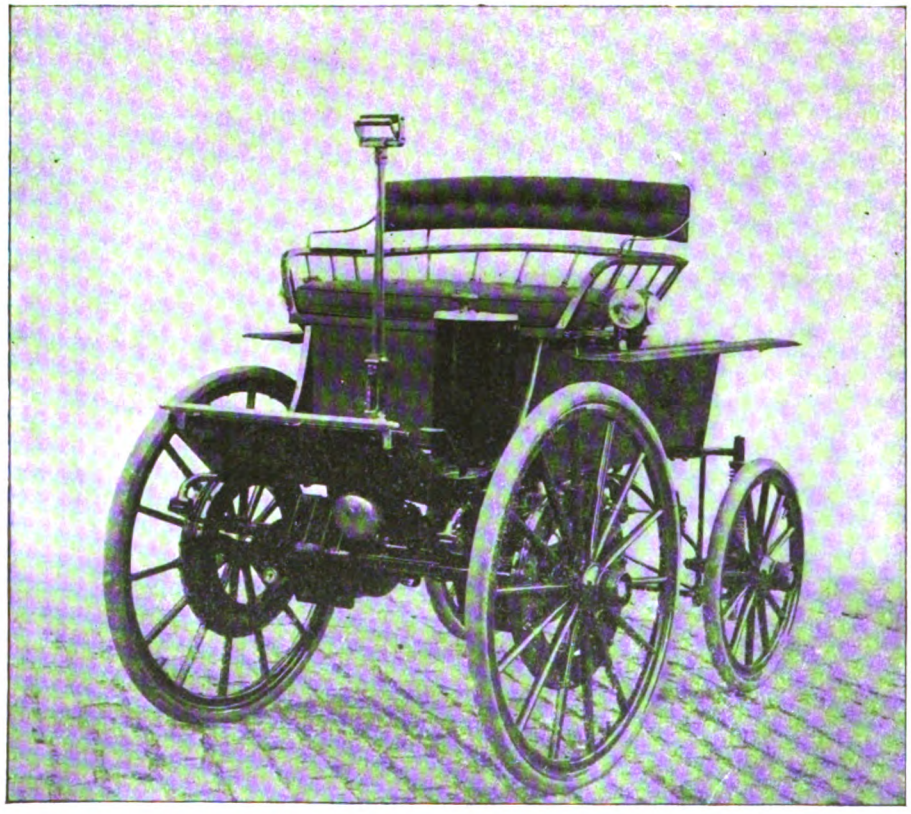
TO TAX FRANCHISES. Senator Ford has introduced in the New York Legislature a bill to tax all lighting, traction, telephone and telegraph franchises.

More Electric Cabs.

The New York Electric Vehicle Company on or about June 1 will place 200 more cabs on the streets. Of these twenty-five will be of the ordinary coupe pattern, seventy-five hansom cabs, fifty full extension broughams seating four persons and fifty three-quarter extension broughams accommodating three persons. The company will establish two more stations in this city, one downtown and another on the East Side. It is also establishing a large factory plant of Forty-second street. The demand for the cabs is positively enormous—two or three times the number available.

Performance of Electric Carriage, with Lundell Motor.

THE successful operation of the Morris & Salom electric vehicles in New York and their extensive introduction in various other cities for pleasure and business purposes is largely due to the very efficient motors employed. They are of the Lundell type which are specially designed for fulfilling the various heavy demands made on motors used for this purpose. The No. 5 carriage is equipped with 44 chloride cells type "3 M" rated ampere hour capacity per cell at 10 hour rate, 70 ampere hours; weight of element, 12 lbs. 2 oz. The weight of battery complete with wooden boxes, rubber jars and acid, was 740 lbs. (estimated). The total distance run, was 34.36 miles, and the actual running time was 4 hours 15 minutes. The average speed was 8.1 miles per hour. The average ampere discharge rate was 15.2 amperes and the ampere hour capacity of the battery at a 15.2 ampere rate, was 64.6 ampere hours. The maximum current required at any one time in this run with the exception of momentary current for starting up was 35 amperes. This test made some time ago, was not made on a selected course, but included a trip from one end of Philadelphia to the other, and through a portion of Fairmount Park, with all the varying grades, railroad crossings and the various kinds of pavements that one would meet in actual practice through a city's streets.



ELECTRIC CARRIAGE WITH LUNDELL MOTOR.

BOSTON & MAINE R. R. is said to be inaugurating a policy of paralleling its own steam lines with electric lines wherever needed, buying up or building.

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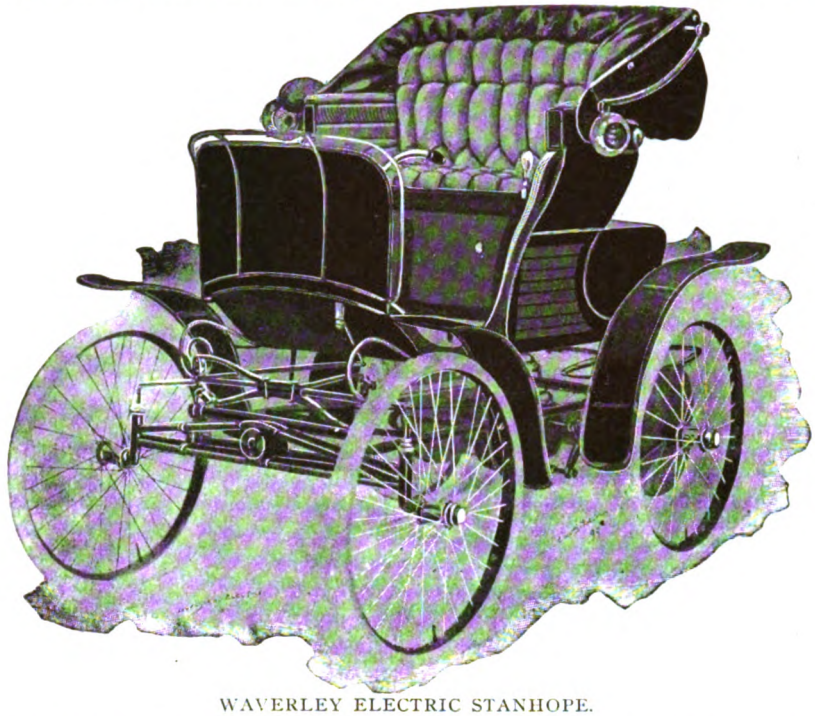
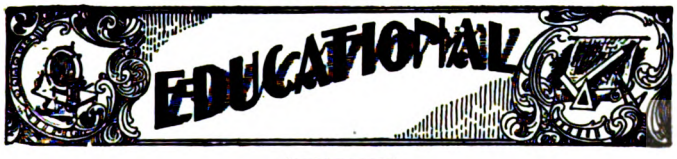
The Waverley Electric Stanhope.

AMONG the many novel and handsome automobiles placed on the market by the Indiana Bicycle Company, Indianapolis, Indiana, their new type of Stanhope illustrated herewith deserves special mention. It is a stylish and beautifully finished pleasure vehicle specially adapted to physicians use. Its weight



WAVERLEY ELECTRIC STANHOPE.

is 1,350 pounds, it contains a 1½ horse power motor and can attain a maximum speed of fourteen miles per hour. Its radius of action is from thirty to thirty-five miles, at the small cost of operation of two cents per mile. The price of this vehicle is $1,200.



Stevens Institute of Technology.

The usual midwinter meeting of the Alumni Association of the Stevens Institute of Technology was held in the large hall of the Stevens School which adjoins the main Institute buildings occupying the block between River and Hudson and 5th and 6th streets, Hoboken, N. J., on the evening of the 15th.

In view of the fact that the 15th is the anniversary of the destruction of the "Maine," it was appropriate that a large part of the session was devoted to illustrated addresses by some of the many graduates who had acted as engineers during the recent war (thirty-three of the graduates who volunteered were accepted, and acted in various engineering capacities throughout the war).

The first speaker was to have been Mr. W. S. Aldrich, M. E., who was stationed on the "Vulcan," which was of such invaluable service according to the testimony of Com. Melville and all others who were in a position to know the facts and have published their opinions. Unfortunately, Mr. Aldrich, who is the professor of Mechanical Engineering at the West Virginia University was "snow bound" on his way, and did not arrive in Hoboken until after midnight. The substance of Prof. Aldrich's intended address will, however, appear in the next number of the "Stevens Institute Indicator," a quarterly journal published by the Alumni Association, and frequently quoted in the technical journals of the country.

The first speaker therefore was Mr. Alexander Dow, M. E., who was a member of the Volunteer Engineer Regiment, recruited so largely from electrical ranks.

Mr. Dow and his companions accompanied the troops sent to Puerto Rico and was there engaged in much lively engineering work during the landing and advance of our troops. His remarks were illustrated with photographs taken on the ground, and were both interesting and entertaining, being enlivened by the description of numerous amusing incidents of the voyage and campaign.

At the conclusion of the above, President Morton was, as usual, called upon for a brief address, and responded by bringing before the meeting the subject of the Alumni Building Fund, which has been allowed to lie quiet during the business depression of the last few years, but which he thought might be with good effect revived at the present meeting. He mentioned that the cash in hand of this fund had already insensibly accumulated to the amount of nearly $20,000, and that the shares of stock which he had himself donated to this fund at the time of the 25th anniversary in 1897 were now salable in the market for over $20,000 more, so that these two items alone footed up $40,000, which might be looked upon as an encouraging "starter."

President Morton then requested Prof. Jacobus, who occupies the chair of Experimental Mechanics and Engineering Physics, to explain certain drafted plans for a new building which he had prepared, and which building with the arrangements of the apparatus and machinery shown in the drafts would greatly improve and facilitate the work of instruction and aid the Institute to maintain the leading position among schools of mechanical engineering which she had achieved and held for so many years.

These descriptions were listened to with attention by the members of the Association, who take a lively interest in the prospects and progress of their Alma Mater, and after some remarks the matter was left to the Executive Committee to take such steps as they might think advisable towards securing such a fund as would warrant the erection of some such building as had been described.

Instructors in The Electrical Engineer Institute of Correspondence Instruction.

All students of The Electrical Engineer Institute of Correspondence Instruction, as well as others connected with the electrical profession will be interested to learn that this enterprising institution has secured the services of Mr. Alfred E. Wiener, the well-known author and electrical engineer, who assumes charge of the Instruction Department as Chief Instructor of the Institute.

Mr. Wiener is not alone an exceptionally well informed engineer, but possesses, as well, the rare gift of imparting knowledge to others. The students of the Institute will be greatly benefited by this arrangement.

Among the corps of authors and instructors which the Institute

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has gathered around it, are now numbered many of the most prominent electrical engineers of the country, so that the student enters upon his studies with the satisfying conviction of having intrusted his electrical education to an institution, the good faith, trustworthiness and technical reliability of which stand unquestioned. Students and those who are desirous of becoming such are cordially invited to call at or write to the home offices of the Institute, 120 Liberty street, New York City, where Mr. Herman A. Strauss, the general manager, will be at all times pleased to discuss or correspond in detail with them as to their individual needs and assist them in selecting the most suitable course.

SOCIETY & CLUB NOTES

New York Electrical Society—194th Meeting—at the Station of the Electric Vehicle Co. Feb. 14th 1899.

THE New York Electrical Society's 194th meeting formed no exception in the matter of drawing a crowded house. There were nearly 270 acceptances of the invitation, which, through the courtesy of the Electric Vehicle Company, the society sent out to its members, and although the city was in the throes of a blizzard and out of town members had to stay at home, nearly 200 persons were present to prove how engrossing is the interest now concentrated on the novel automobile question.

The visitors were received by Mr. Isaac L. Rice, the president, and Mr. F. Vieweg, the general manager of the company; and the business meeting was held in the main office. Unfortunately Mr. G. Herbert Condict, the company's electrical engineer, who was to have read a paper on the automobile situation and prospects, was stalled in Philadelphia by the snowstorm, but Mr. W. F. D. Crane, one of the engineers of the company, kindly gave a short talk which enabled every one present to form an intelligent idea of the equipment about to be inspected, and the method of carrying out the various operations involved in the business of an electric cab station.

Notwithstanding the fact that the quarters at 1684 Broadway are already too cramped for the traffic of the company, the large crowd, under the admirable direction of Mr. Gilbert, was conducted over the building without the slightest confusion. Each small party was in charge of one of the company's employees, who explained the working of the respective departments. Seats for ladies were placed in the gallery, where a collation was served. Not the least interesting part of the evening's programme was the watching of the electric cabs as they came in to renew their stores of energy. Some of the vehicles had "fares" in full dress on the way to or from the theater or opera, and as the cabs wheeled and backed deftly, responsive to the lightest pressure of the controlling gear, a convincing lesson was afforded of the phenomenal handiness of this new and important adjunct to the resources of transportation. The hold which the electric cab has taken on New Yorkers is seen in the fact that the eighty-four cabs now in daily use, for which there are frequently orders three deep between nine in the evening and twelve o'clock, are to be supplemented immediately by 200 more vehicles of various kinds; and it is believed that even this addition to the equipment will soon prove inadequate to the demands of the traffic. A suggestive feature of the business now done is the engagement by private persons of a large proportion of the vehicles, and the coachmen of many of the society leaders of the city are engaged in putting the finishing touches to their tuition in the now essential part of their education, the management of the electric automobile.

Mr. Crane, in the course of his remarks, said: As your president has remarked, the carriage body, as it appears upon the wheels here to-day, is what we got from those who have gone before; it is a work of the past. The running gear below is a little more up-to-date. In this matter the engineer is confronted with the fact that he is trying to combine the old with the new. The body is not connected with the running gear below, and so far the running gear below is inadequate for the service required of it. But if some radical change were made in the appearance and shape of that body; if a vehicle very different in appearance from what you see here should be put upon the streets, the people generally would probably criticise it as being queer. Yet we can expect as the natural development of the vehicle goes on to have what would now seem queer shapes appear upon the streets, and they will no doubt start a new fashion in vehicles.

One of the difficulties that must be faced in designing the mechanism to run the cab or carriage, is the spring-body. You must have a running gear, truck, wheels, axles, whatever you call it, below, fairly rigid and stationary to receive your machinery and at the same time make all allowances for the spring motion, which contributes to the comfort of the rider. This carriage at present does not seem to follow any known laws of ordinary machines, where things are made rigid and fast. For example, when these cabs leave this building, and they are obliged to make a quick turn, the front wheel will go on to the roadway and the other three wheels will remain on the sidewalk, meaning an elasticity throughout all the lower part of the vehicle; whereas the old-fashioned springs take the weight of the vehicle the best way they can. Changes are under way to so modify the lower structure as to make it stronger and more durable. One of the first things to be done is to make the vehicle so that it will not go to pieces. All parts wear out, and the electric vehicle manufacturer is going through the same stage that the street car builders did in times past.

I suppose you will be most interested in the way in which the motors, batteries, switches, etc., are combined in the vehicle. The motors are placed upon the axle, two of them in this case here, with the gear rigidly fixed upon the wheels. These wheels are not rigid with the axles, but are independent. The pinion upon the motor comes out and meshes with the gear which is attached to this wheel, so you can imagine the result if one motor ceased to revolve, and the other did—the thing would spin around. The steering arrangement, as you may have noticed, is applied to the hind wheels. The axle does not turn with the wheels, but the wheels are arranged upon separate spindles, which are hinged to the axle, which is rigid with the body attached to the springs. The wheels are operated by the steering mechanism, so as to produce the steering action.

The batteries, as you may also have noticed, are placed within the cab, either from the front or rear, dependent upon the character of the vehicle, whether a brougham or hansom. These batteries when shoved into the vehicle make automatic contact, so that the operator has nothing to do except to put the door over the compartment. The motorman, or driver, as he is still called, has everything within hand's reach or foot reach at his side. With his hands he operates the controlling lever for operating the switch beneath his seat; he also steers with his hand. The braking is done with his foot, and he rings the bell with his foot. There is an emergency switch placed near his heel, by which he can throw out the switch and break the current in case it is necessary to do so. In order that no tampering with the vehicle can take place while he is absent, he can remove the lever, so that the machine cannot run away if an idle boy attempted to fool with it.

One of the difficulties that appears in this particular line of work, as it does also in storage battery practice for other classes of work, is that when you place the batteries within the vehicle—these batteries weigh between 1,300 and 1,500 pounds—the vehicle sags. For that reason you will notice later, when you inspect the batteries and loading table below, there is an arrangement to lift the body of the vehicle so as to bring the floor of the battery compartment on a level with the table over which the batteries come. This feature has been most ingeniously worked out here, and I think I am right in saying that Mr. Condict deserves the greatest credit for the ingenuity he has shown in designing the various movements that you see below for the handling of these batteries; for, of course, the batteries, which take the place of horses, fuel, steam and all other methods of propulsion, are the essential elements in the whole problem—that is, to handle that heavy mass quickly, economically and satisfactorily. You will see the batteries picked up and carried around sideways, backward and frontward, as if they had no weight at all; but when you think of their weighing almost three-quarters of a ton, you can readily appreciate that it took some ingenuity and requires a great deal of stanchness in the batteries, to handle them so quickly and easily. In street cars run by storage batteries, one of the early difficulties was to get the car to a position where you could put in the battery. The same thing occurred with the

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electric cab; but the difficulty has been overcome by that table which you see upon the floor, on which the cab stands. The table is split in two parts, and balanced below, so that the parts are free to move in either direction sidewise. The cab enters and takes its position on any part of that table. Then levers forced by hydraulic cylinders on the sides come up and engage the hubs, and make the movement which forces the cab in a right line to the table, or makes the side parallel with these levers. That is a great improvement and a vast step in this business, to conceive such a remarkable way of aligning the carriage with the battery which is to enter it. While this is going on, you have the jacks coming up under the floor of the table, also operated by hydraulic power, to raise the carriage to the level of the table. Meanwhile, the batteries which have been charging on the tables further on behind have been brought forward by the crane. This operation is very simple. While the cabs are on the street they are using the charge which has been put into the batteries. When they come back they require a new charge. The cab or carriage as it enters upon this table is centered as described and raised to the proper level, and a hydraulic ram comes out, takes hold of the batteries and pulls them out so far that they are left on the table which carries them sidewise. These discharged batteries are then moved out of the way, and a set of batteries which have been charged and which are resting upon the table are brought opposite the opening in the cab, and the ram makes a movement forward and forces the batteries into the carriage. Then the set which has been exhausted is picked up by the automatic jaws of the crane, carried down the length of the room, and deposited upon a table where they will be recharged and made ready for service next time.

The operation of the station here is certainly most fascinating. I think you could all come up here—you who are interested in mechanical problems—and sit upon this balcony several times a week and watch the loading and unloading take place, and find it always a matter of interest to you. There is a great deal to be improved upon, of course; although it would appear now as though the shortness of time required to load the vehicles could not be very much reduced. The other evening a cab came in, the old battery was taken out and a new one put in, in a minute and a quarter. This is prompt work, and it would be impossible to unharness horses and harness them again in that time.

Mr. Mailloux suggests that something be said about charging the batteries. When the batteries are let down on the charging table, they are caught in automatic contact by jaws coming up on the side. On the battery boxes are contacts which fit similar contacts in the cab and also the contacts upon these tables. As the battery falls, the contacts are driven up on the side, and the contact is automatically made with the switchboard, and the charging takes place in the regular way.

American Institute of Electrical Engineers.

The regular monthly meeting of the Institute was held at 12 West 31st street, New York, on Wednesday evening, February 15, a week earlier in the month than usual on account of the regular date falling upon Washington's birthday. A paper was read by Robert McA. Lloyd entitled "Storage Batteries and Railway Power Stations." It was discussed by: Messrs. Hill, Mailloux, Birdsall, Coho, Smith, Holmes, Henshaw, Bijur and others. A meeting of the Western members was also held on the same evening at the rooms of the Technical Club, 228 South Clark street, Chicago, where Mr. Lloyd's paper was also read and discussed.

At the meeting of the Executive Committee in the afternoon the following associate members were elected: Frank Pierce Adams, Electrician, Stockton Gas & Electric Co., residence, 171 N. El Dorado St., Stockton, Cal. Julius Le Roy Adams, Chief Engineer, Hartford, Manchester & Rockville Tramway Co., Manchester, Conn. Paul K. Browd, Chief Engineer, The Russian Electric Company, Union St., Petersburg, Russia. N. M. Currie, Superintendent, The Municipal Electric Light Plant, Conneaut, Ohio. John Sturges Codman, Consulting Engineer, associated with R. S. Hale, 31 Milk St.; residence, 57 Marlborough St., Boston, Mass. Clifford E. Dunn, Patent Attorney, 229 Broadway, New York City, residence, 12-a Monroe St., Brooklyn, N. Y. Charles William Hutton, Chief Electrician, Sacramento Electric Gas and Railway Co., Sacramento, Cal. Edmund Oscar Schweitzer, Electrical Inspector, Chicago Edison Co., 139 Adams St.; residence, 196 Oakdale Ave., Chicago, Ill. Arthur E. Truesdell, Assistant to General Superintendent, Peoples Light and Power Co., 443 4th Ave., Newark, N. J. Marcus B. Waterman, Electrical Engineer, Brewster Engineering Co., New York City, residence, 177 Lefferts Place, Brooklyn, N. Y. John Shreeve Wise, Jr., Electrician, The Pa. Mfg. Light and Power Co., residence, 2023 Mt. Vernon St., Philadelphia, Pa.

Mr. George T. Hanchett, consulting electrical engineer, New York City, was transferred to full membership.

Mr. A. L. Riker on "The Horseless City."

A very interesting paper on "The Horseless City, or the Age of the Automobile" was read on February 17, before the Quid Nunc Club of New York City, by Mr. A. L. Riker, President of the Riker Electric Company. The paper was accompanied by a number of lantern slides illustrative of various types of automobiles, including a great many worked out by the speaker himself during fifteen years devotion to this new and growingly important art. In spite of the terrible weather, there was an excellent attendance. Among those present and participating were: Messrs. Charles A. Terry, Frankland Jannus, J. K. Hoyt, Spencer Peets, T. C. Martin, Dr. Berkens and Prof. J. F. Kemp, of Columbia University. Several ladies also took part in the discussion, the paper eliciting a perfect fusillade of inquiries, showing remarkably how deep is the general and popular interest in this latest work in the field of transportation.

OBITUARY

Bradner P. Holmes.

Bradner P. Holmes, general manager of the Youngstown Electric Light Company, died at the Youngstown City Hospital, last week, after a short illness from grip. The deceased was a prominent public spirited citizen, member of Masonic Fraternity, Royal Arcanum, and was president of the Board of Education. He was 45 years of age and leaves a wife and two children. He was well-known in electrical circles in Ohio and highly esteemed.

PERSONAL

MAYOR F. O. BEAL, of Bangor, Me., and president of the Penobscot Central Railroad, has made an assignment to Mr. E. C .Ryder, with liabilities of $100,000, and assets of $85,000. He proposed to use Patton motors on his road, and tried to bond it for that purpose, but failed. Mr. Beal says he has two dollars for every dollar he owes.

GEN. E. S. GREELEY, of the Yale National Bank, was one of the storm-bound visitors in New York, last week. He is now absorbed in banking affairs, but is frequently consulted on electrical matters by investors in the Nutmeg State.

MR. EUGENE INGOLD, chief inspector of the Bureau of Electricity, Pittsburg, is battling with the smoke problem in that city.

MR. S. M. HAMILL, of the Brush Electric Company, gave the New York Sun an admirable interview, last week, on the subject of expansion, and stated truly that the sentiment overwhelmingly of the electrical industries of America is for what is known as "imperialism," meaning thereby a policy of pushing American goods and American interests boldly all over the earth. He believes heartily in "colonies" also.

COLVILLE, WASH. The Columbia & Northern Telephone and Telegraph Co., formed recently, has a capital stock of $150.00. It has a 50-drop switchboard, and 40 subscribers, with 20 miles of local copper circuit, No. 14. The rate is $2.50 per month. The officers are J. B. Slater, C. W. Winter and W. W. Pankey.

NEW YORK EDISON CO. has re-elected its old directors for the present.

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INVENTORS' RECORD

Classified Digest of U. S. Electrical Patents Issued Jan. 31, 1899.

Alarms and Signals:—

FIRE ALARM. Franklin D. Wallace, of Wheatland, Ind., 618,526. Filed June 1, 1898. The circuit closing or opening mechanism is released by the melting or burning of a fusible plug.

SIGNAL CONTROLLING TRACK INSTRUMENT. Edgar A. Hollaway, Gilroy, Cal., assignor of one-half to Frank U. Reeve, of San Jose, Cal., 618,604. Filed April 14, 1898. Details of construction.

SIGNAL MECHANISM. Herbert W. Peirce, Waltham, Mass., 618,723. Filed July 7, 1897. This invention has reference to improvements in signal mechanism, and particularly in extension signals beyond the main electric circuit.

AUTOMATIC CIRCUIT CLOSER. Henry F. Blackwell, Jr., New York, N. Y., 618,773. Filed Jan. 8, 1898. A means for switching the Gamewell standard cut-out fire alarm signal boxes into circuit.

Batteries, Primary:—

ELECTRIC BATTERY. Arthur Reginald Adams, Surrey, England, 618,635. Filed March 29, 1897. A process of compounding an exciting fluid for electric batteries, consisting in preparing first a solution of chromate of potassium, adding sulphuric acid, then adding a solution of nitrite of sodium, and then adding a solution of nitrite of mercury, and then mixing thoroughly at a temperature at about 150° Fahrenheit.

Batteries Secondary:—

STORAGE BATTERY. Ralph Ashley, Port Republic, N. J., assignor by direct and mesne assignments to the Guarantor Electric Co., Camden, N. J., 11,713. Filed April 9, 1898. Consists in a battery composed of a number of cups or trays of rubber or other suitable insulating material, arranged in a vertical stack or pile, but out of contact with each other.

Dynamos and Motors:—

ALTERNATING CURRENT MOTOR. Edward C. Newcomb, of Brookline, Mass., assignor to the Holtzer-Cabot Electric Co., of same place, Boston, Mass., and New York, N. Y., 618,578. Filed May 16, 1898. Employs a field magnet, whose numbers of ampere turns gradually diminish from the outer edges of the poles to the centre by a sine function.

COMMUTATOR SHORT CIRCUITER. Edward C. Newcomb, Brookline, Mass., assignor to the Holtzer-Cabot Electric Co., Brookline, Mass., and Boston, Mass., 618,579. Filed June 21, 1898. Comprises a commutator, a conductor adapted to come into contact with the segments of the commutator, a handle, rotatable relatively to the commutator, for moving the conductor away from the commutator and means for locking the handle to the shaft in the "On" and "Off" positions.

DIRECT ACTING RECIPROCATING ELECTRIC MOTOR. James H. Mason, of New York, N. Y., 618,702. Filed May 24, 1897. Details of construction.

ARMATURE FOR DYNAMO ELECTRIC MACHINES. Edward D. Priest, Schenectady, N. Y., assignor to the General Electric Co., New York, 618,727. Filed Aug. 26, 1898. An armature for a dynamo electric machine, comprising a toothed body of metal, having coil slots between the teeth, the teeth being so arranged that they decrease in height toward the slot adjacent thereto, and coils mounted in the slots.

Electro-Metallurgy:—

METHOD OF AND APPARATUS FOR PRODUCING CHLORIN, ZINC OR OTHER METALS FROM MIXED ORES. Farnham Maxwell Lyte, of London, England, 618,575. Filed Dec. 30, 1897. An electrolytic cell, a cathode, and anode having an enlarged lower end portion and provided with a plurality of openings or passages through the lower end portion only, and situated over the cathode and means for heating the cell.

Lamps and Appurtenances:—

APPARATUS FOR MANUFACTURING FILAMENTS FOR ELECTRIC LAMPS. Hiram S. Maxim, 618,703. Filed Nov. 8, 1898. See page 174.

METHOD OF MANUFACTURING FILAMENTS FOR INCANDESCENT LAMPS. Hiram S. Maxim, 618,704. Filed Jan. 5, 1899. See page 174.

ELECTRIC LAMP. John Sloane Mead, Mt. Vernon, N. Y., 618,706. Filed Sept. 19, 1898. Consists of a battery and incandescent lamp contained within a casing of convenient size to be carried in a person's pocket and a reflector placed at one end of the casing nearest to the lamp.

Miscellaneous:—

ELECTRIC FURNACE. Hugues Bovy, of Geneva, Switzerland, assignor to La "Volta" Societe Anonyme de L'Industrie Electro-Chimique, of same place, 618,391. Filed April 14, 1898. Designed for the manufacture of calcium carbide and is so constructed that the spot where the heat is greatest is located as to permit the vapors produced by the volatilization of the materials treated to escape only through the materials which have been already melted. See page 203.

ELECTRIC PUMP. Carl Eickemeyer, of Yonkers, N. Y., 618,404. Filed Jan. 22, 1898. Comprises pumping mechanism and gear casing forming the support of part of the driving mechanism of the same, a motor, and a gear and worm turning in the casing, the worm having a combined worm and ratchet motion. See E. E. Feb. 16.

CARBON FEEDING MECHANISM. Edward Powell Hopkins, of New York, N. Y., 618,509. Filed March 21, 1898. Adapted for use in electric furnaces designed for the reduction of calcium carbid.

MEANS FOR PURIFYING LIQUIDS. Dexter Reynolds, of St. Louis, Mo., 618,522. Filed April 3, 1897. Consists of a series of filtering tanks, each containing two electrodes, from which the water is strained and passed into filtering apparatus.

VENTILATING APPARATUS. Frank P. Donahey, of Washington, D. C., 618,562. Filed Aug. 10, 1898. To operate transoms and other ventilating devices a mechanism automatically actuated by a change in temperature.

ELECTRIC ILLUMINATED CLOCK DIAL. Richard T. Crane, Jr., Chicago, Ill., 618,646. Filed Feb. 18, 1898. The indicating characters on the clock dial are illuminated as the hour hand passes over them, the minute hand being kept in a constant state of illumination. See page 203.

ELECTRIC CLOCK. Walter W. Hastings, Jersey City, N. J., 618,670. Filed Nov. 24, 1897. Details of construction.

AUTOMATIC STOPPING MECHANISM FOR ENGINES. Victor E. Hunter, Cleburne, Texas, assignor of one-half to Jacob D. Oliger, Cleburne, Texas, 618,679. Filed May 20, 1898. Comprises means in connection with a rotary shaft whereby the supply of steam to the engine may be cut off in the event of the rotation of the shaft becoming too rapid.

PREPAYMENT ELECTRIC METER. F. M. Long and Ernest Schattner, Norwich, England, 618,699. Filed July 18, 1898. Coin-controlled mechanism. Details of construction.

PROCESS OF MANUFACTURING A SUBSTANCE HAVING INSULATING PROPERTIES. Fred. Lamplough, London, England, 618,692. Filed May 31, 1898. Consists in submitting vegetable fibrous material, together with an oxidizable resin and a non-oxidizable oil, to the action of a destructive heat and oxidation.

Railways and Appliances:—

ELECTRIC RAILWAY. James F. Munsie, of New York, N. Y., assignor of one-half to Thomas L. Coles, of same place, 618,429. Filed July 26, 1897. A circuit closing box for a surface contact system, containing a movable circuit closer, a grooved cover into which the circuit closer projects, and sloping walls above the circuit closer.

TROLLEY. David J. Brown, of New York, N. Y., 618,534. Filed Dec. 1, 1897. Comprises a trolley pole having side plates at its free end, a trolley wheel journaled between the plates, guide arms carried by the journals of the wheel, detachable side pieces carried by the guide plates and an arm yieldingly held in each of the pieces.

TROLLEY SLEETER. James B. Mock, of Fort Wayne, Ind., 618,577. Filed Jan. 28, 1898. Details of construction.

TROLLEY WHEEL AND SUPPORT. William P. Holt, Savannah, Ga., 618,674. Filed June 2, 1898. Comprises a trolley pole, a gimbal support for the wheel carried by the pole, a trolley wheel mounted in the gimbal support, and a weight rigidly suspended from the gimbal support.

Switches, Cut-Outs etc,:—

ELECTRICAL PROTECTOR. David J. Cartwright, Boston, Mass., assignor to the Electrical Safety Co., Boston, Mass., 618,812. Filed Jan. 11, 1897. An electromagnetic cut-out, in which there are two armatures, one of which is attracted by the effect of any increase of current beyond that which the protected device can bear without injury and the other armature is attracted by a stronger current and acts when attracted to establish connection with a shunt containing a resistance.

Telephones:—

TELEPHONE SWITCHBOARD. James M. Overshiner, Elwood, Ind., 618,610. Filed Oct. 10, 1898. Embodies a jack, a drop and a plug, combined with a drop-restoring device actuated by the plug to restore the drop only when the plug is withdrawn from the jack.

Classified Digest of U. S. Electrical Patents Issued Feb. 7, 1898.

Alarms and Signals:—

AUTOMATIC ELECTRIC SIGNAL FOR RAILWAY CROSSINGS. Urias J. Fry, of Milwaukee, Wis., 619,038. Filed Sept. 26, 1898. Details of construction.

COMPOSITE SIGNALING AND TRANSMISSION SYSTEM. S. D. Field, 619,157. Filed Dec. 24, 1897. See page —.

Batteries, Primary:—

ELECTRICAL BATTERY. Leonard Paget, of New York, N. Y., assignor to the Reliance Lamp Electric Co., of New Jersey, 618,993. Filed July 8, 1897. A battery having a metallic retaining vessel, in combination with a metallic electrode which fits snugly within the vessel, the electrode and the inner surface of the vessel being amalgamated.

Conductors, Conduits and Insulators:—

CONDUIT FOR WIRES OR CABLES. Edward H. Callaway, New York, N. Y., 618,837. Filed Dec. 24, 1897. Comprises perforated sections of suitable non-conducting material so constructed as to be readily put together.

Dynamos and Motors:—

BRUSH HOLDER FOR DYNAMO ELECTRIC MACHINES. Gano S. Dunn, East Orange, N. J., assignor to the Crocker-Wheeler Electric Co., New Jersey, 618,853. Filed April 30, 1898. Comprises a brush holder rigging centered upon the axis of the commutator and revoluble in a circle concentric thereto, and brush holder supports mounted upon the rigging and independently adjustable thereon circumferentially around the commutator, and adjustable together around the commutator by the movement of the rigging.

ROTATING ELECTRIC MOTOR. Warren P. Freeman, New York, N. Y., assignor of two-thirds to Robert J. Campbell, of same place, and Francis Larkin, Jr., Sing Sing, N. Y., 618,935. Filed Feb. 25, 1898. Comprises a standard, a motor pivotally mounted thereon and turning on annular friction reducing bearings, a yielding and pivotal connection for one of the terminals of the motor in the axial line of the bearings and a concentric contact ring and brush for the other of the terminals.

CLEANER FOR COMMUTATORS. John T. Morrow, Great Falls, Mont., 618,992. Filed Sept. 29, 1898. Means for drawing cleaning fabric or material over the surface of the commutator and means for pressing the material yieldingly against the commutator.

ELECTRIC MOTOR. Oscar H. Pieper and Alphonse E. Pieper, Rochester, N. Y., 619,217. Filed March 21, 1898. Comprises an annular magnet embodying two sections, each composed of separate plates secured together and having the projections forming the interior pole-pieces and the exterior depressions, the ends of the plates lapping, means for securing the lapped ends together and the bearing plates on the magnet opposite the exterior depressions.

Lamps and Appurtenances:—

ELECTRIC ARC LAMP. Walter Edward Dennis, New York, N. Y., 618,848. Filed Jan. 22, 1898. Feed mechanism. Details of construction.

ELECTRIC ARC LAMP. Thomas E. Drohan, Chicago, Ill., assignor to the Siemens & Halske Electric Co. of America, same place, 619,014. Filed Dec. 1, 1898. Means for cutting a lamp out of circuit during the

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time in which the trimmer is engaged in supplying it with fresh carbons.

ELECTRIC ARC LAMP. Albert Schweitzer, Allegheny, Pa., 619,090. Filed June 7, 1898. Feed mechanism for enclosed arc lamps of either direct or alternating current type.

Measurements:—

ELECTRO-CHRONOGRAPH. Clark W. Thompson, La Crosse, Wis., 619,028. Filed June 27, 1898. A device designed to measure and record intervals of time during which an electric circuit is energized, a number of such intervals being recorded in an aggregate amount.

PREPAYMENT MECHANISM FOR ELECTRIC METERS. J. C. Kinney, San Antonio, Texas, 619,187. Filed April 18, 1898. A meter and the main circuit for its coil is combined with a normally open circuit-closer included in the meter circuit magnetically controlled, means for respectively opening and closing the circuit closer, a coin-controlled device for setting into action the means for closing the circuit-closer, and a separate device for setting into action the means for opening the circuit-closer.

Miscellaneous:—

TROLLEY CONNECTION FOR CANAL BOATS. Frederick John Shewring, Toronto, Canada, 618,911. Filed Feb. 7, 1898. Employs an overrunning, gravity-balanced trolley connected to the pole by means of wire or flexible cord.

ELECTRIC HAND LIGHTING GAS BURNER. Henry C. Thomson, Boston, Mass., assignor to the Electric Gas Lighting Co., of same place, 618,920. Filed May 31, 1898. Details of construction.

TORPEDO CONTROLLING DEVICE. Walter D. Litchfield, Somerville, Mass., 619,023. Filed Aug. 30, 1897. Renewed Nov. 17, 1898. Employs power generated or stored within the vessel, two step-by-step devices carried by the vessel for controlling its mechanisms and operated by the making and breaking of two circuits at a distance from the vessel.

ELECTRIC CRANE. W. R. Thomas and Jas. Thomas, Catasauqua, Pa., 619,100. Filed June 6, 1898. An electric motor is employed which is connected to the hoisting apparatus proper by means of bevel gearing.

Railways and Appliances:—

APPARATUS FOR OPERATING ELECTRIC BRAKES. Herman S. Graber, St. Louis, Mo., 518,864. Filed July 25, 1898. Comprises a storage battery, an electric motor, a charging and motor-operating circuit, in which they are arranged in series; an electromagnet permanently out of circuit with the motor, a second circuit receiving no electricity from the first circuit, and in which the battery and magnet are arranged, and means for opening and closing the second circuit.

TROLLEY POLE AND WHEEL. Fritz Kramer, Blythedale, Pa., 619,080. Filed May 11, 1898. Embodies means designed to keep the trolley in contact with the wire.

TROLLEY POLE. Philip H. Gilbert, Hazleton, Pa., 619,164. Filed April 7, 1896. Comprises a trolley and pole to which a short pole is attached having a trolley for the purpose of clearing the conductor of ice.

TROLLEY CATCHER. Charles Herbert Ocumpaugh, Rochester, N. Y., 619,213. Filed Nov. 26, 1897. Comprises an enclosing frame having an offset, a spring containing drum provided with a rack, a dog independently supported in the offset, a spring and a strap adapted to directly lift the dog, the offset being situated at the top of the frame at the opposite side thereof with respect to the strap and out of its path and adapted to stop the dog when the latter is lifted.

Switches, Cut Outs, etc:—

CIRCUIT BREAKER AND CLOSER. Alva T. Hill, Detroit, Mich., assignor to Ross & Holden, of same place, 618,876. Filed June 8, 1897. A signaling mechanism for guarding railway crossings in which open signal and track circuits are employed, with an alarm mechanism arranged in the signal circuit.

LIGHTNING ARRESTER. Eugene Chilton Parham, Johnstown, Pa., assignor to the Steel Motor Co., of same place, 618,950. Filed June 26, 1897. Employs two pairs of normally separated electrodes, and means for simultaneously increasing the gap between one of the pairs and closing the gap between the other of the pairs when current is flowing through the device.

RESISTANCE PANEL OR GRID. Alva C. Dinkey, of Munhall, Pa., 618,954. Filed June 20, 1898. An expansible frame for resistance material, the frame having a loose connection to allow a change in its length during the expansion or contraction of the resistance winding.

AUTOMATIC MAGNETIC CIRCUIT BREAKER. William M. Scott, Philadelphia, Pa., assignor to the Cutter Electrical and Mfg. Co. of New Jersey, 619,091. Filed Jan. 28, 1898. Embodies fixed and movable contacts with means for effecting the separation of the movable contacts from the fixed contacts, means for restraining the operation of the separate means until actuated to permit the same, means for actuating the restraining means, and an electromagnet and armature for controlling the actuating means during predetermined flow of current through the magnet, and a pivoted lever adapted to be manually operated to force the armature into engagement with the poles of the magnet.

Telephones:—

SWITCH HANDLE FOR TELEPHONE CALLS. Oren R. Cline, El Dorado, Kan., assignor to L. Sands, Cleveland, Ohio, 619,034. Filed Aug. 8, 1898. An operating crank for magneto-calls, consisting of a bushing, a contact sleeve united firmly to the bushing and insulated electrically therefrom, and a spring-controlled crank mounted movably upon the bushing and normally engaging with the sleeve.

TOLL COUNTER OR REGISTER FOR TELEPHONIC CIRCUITS. George K. Thompson, of Malden, Mass., assignor to the American Bell Telephone Co., Boston, Mass., 619,240. Filed June 21, 1898. Details of construction.

Trouble with the Onawa Municipal Plant.

A special despatch from Onawa, Ia., of February 11 says: The fight between part of the city council and the electrician of the city plant culminated at the last council meeting in the resignation of T. W. S. Wade, engineer of the plant. For the last eight years service has been very poor, resulting in many business men putting in their own plants. The council blames the management and the engineer claimed that the plant was insufficient for the work required.

LEGAL NOTES

Thomson-Houston Electric Co., vs. Nassau Electric Road.

The Nassau Electric Railroad Company gave a note for $20,000 to the Thomson-Houston Electric Company in settlement of a suit brought against it in the United States Circuit Court, New York, for the infringement of certain of its electrical patents in constructing and operating the cars of the company's road. A preliminary injunction against the Nassau Company had been continued, which by this agreement was to remain in force, and that company was authorized to use these patents, and the Thomson Company agreed to furnish promptly at all times, upon certain terms, any trolley equipments required by the Nassau Company. On this note $2,500 had been paid, and then a suit was brought in the Supreme Court, in Brooklyn, by the General Electric Company, to recover the balance of $17,500 due upon the note from the Nassau Company. A year later, in action in the United States Circuit Court, in Massachusetts, by the Thomson Electric Company against the Hoosic Railroad Company, the patents of the former, which were the grounds of the suit against the Nassau Company, were decided to be void. The Nassau Company then set up that judgment as a defence in the action against it, the want of a valid patent, and failure of consideration for the note. A counter claim was also interposed for the $2,500 paid. The Second Appellate Division has affirmed judgment entered upon the report of a referee in favor of the plaintiff.

The Court held (Justice Hatch giving the opinion), that there was no failure of consideration when the twenty-thousand-dollar note was given. The letters patent were of approved form and validity, and both parties acted in good faith in making the settlement, and with a full understanding of the situation. The case was clearly one of settlement and compromise of a claim. Such compromises were held to furnish a good consideration to support a payment or a promise to pay thereunder, and in the absence of fraud or misrepresentation such settlements were legally binding. It mattered not that the claim settled had no validity, otherwise there never could be a secure settlement of a contested claim, which it was the policy of the law to promote. That the present plaintiff was not a party to the action in which the compromise was made in nowise affected the promise to pay the notes.

Sprague Elec. Ry. & Motor Co. vs. Nassau Elec. R. R. Co. of Brooklyn.

In re case of Sprague Electric Railway & Motor Co. vs. The Nassau Electric Railroad Co. of Brooklyn, on Sprague Electric Railway Motor Suspension Patent No. 324,892 under date of June 20, 1898, an order was entered in the United States Circuit Court, Eastern District of New York, granting a preliminary injunction restraining defendants from infringing this patent, and the injunction was served on June 21, 1898. Thereupon the defendants undertook to go outside the terms of the injunction by substituting blocks of wood in place of the springs of the apparatus enjoined.

The complainants then moved to punish the defendant for attempting to avoid the terms of the injunction, and at the same time brought a new suit against the defendant for using the altered apparatus. Under date of June 24, 1898, Judge Lacombe decided both cases. In the first case, defendants were held to be in contempt of court and fined $25 per car for disobedience of injunction, that is, $25 for each separate car enumerated by complainants in their affidavits. In the second case, the injunction was granted under Claims 2 and 6 of the patent against the substituted block, bolt and nut device and the defendant was required to remove 250 of the infringing devices within sixty days from the date of the hearing for injunction and to thereafter remove at least 300 of such infringing apparatus within each period of thirty days thereafter until all of such infringing apparatus has been removed.

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The Stock Market

Recovering from the Storm.

There has naturally been some doubt and inquiry as to the effects of the storm of last week, but Bradstreet's is able to report that the damage is far less serious than might be expected. Even in the South, where the fruit crops may show effects from the unprecedented frost, there is the offset that the chances of yellow fever were by the same agency practically eliminated from consideration. While the railroads suffered, if all the hotels were as crowded as those of New York, they must have reaped a golden harvest indeed. As a matter of fact, the welcome thaw has brought with it a tremendous resumption of industrial activity.

During the past week, stocks in Wall street were dull on account of storms and holidays, but prices have been well sustained. Western Union on 5,496 shares was firm around 95. New York Edison rose to 197¼. General Electric on sales of 9,940 shares reached 112⅞. Metropolitan Street Railway retained its vigor and on 37,805 shares rose higher again to 244½. Manhattan Elevated, under Tammany assaults, was rather weak at about 109-111. In Boston, Am. Bell Telephone made the sensational jump of 55 points in one day, and closed at 371, or 41 points above the preceding week. West End Railroad was steady at 93. In Philadelphia, Electric Storage Battery was strong at 125 on large sales, accompanying a change of control. In New York City, Electric Vehicle has had a deserved boom, the preferred selling at 91½, and the common at 69. The other day they were a football in the Street, but earnings are increasing very rapidly and the demand for the service is insatiable.

Copper New York is 18 cents. Heavy rail, Eastern Mill, is $20. Tin was a shade weaker, at $23.75, but is still "way up."

Trade Notes and Novelties

Photometer for the Fostoria Incandescent Lamp Co.

A MODIFICATION of the Queen Standard Photometer, as made for the Fostoria Incandescent Lamp Co., is shown herewith. It was designed from suggestions of their Mr. Hart, and manufactured by Queen & Co., of Philadelphia. The lamp

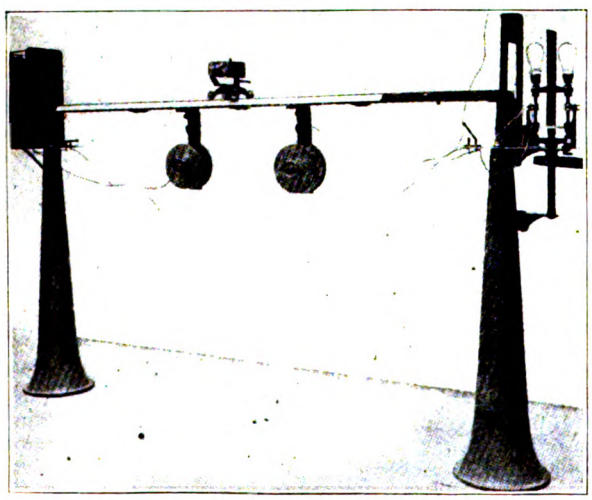

FIG. 1.—PHOTOMETER FOR FOSTORIA LAMP CO.

manufacturer is often under contract whereby his lamps are sold at a rate depending upon the results of tests on a certain percentage delivered, and, therefore, he must be absolutely assured of their uniformity and correctness. But a small amount of time can be placed individually on the lamps in testing them, so the photometer must be possessed of the greatest accuracy and rapidity of measurement.

Fig. 1 presents the complete instrument. At the left is a

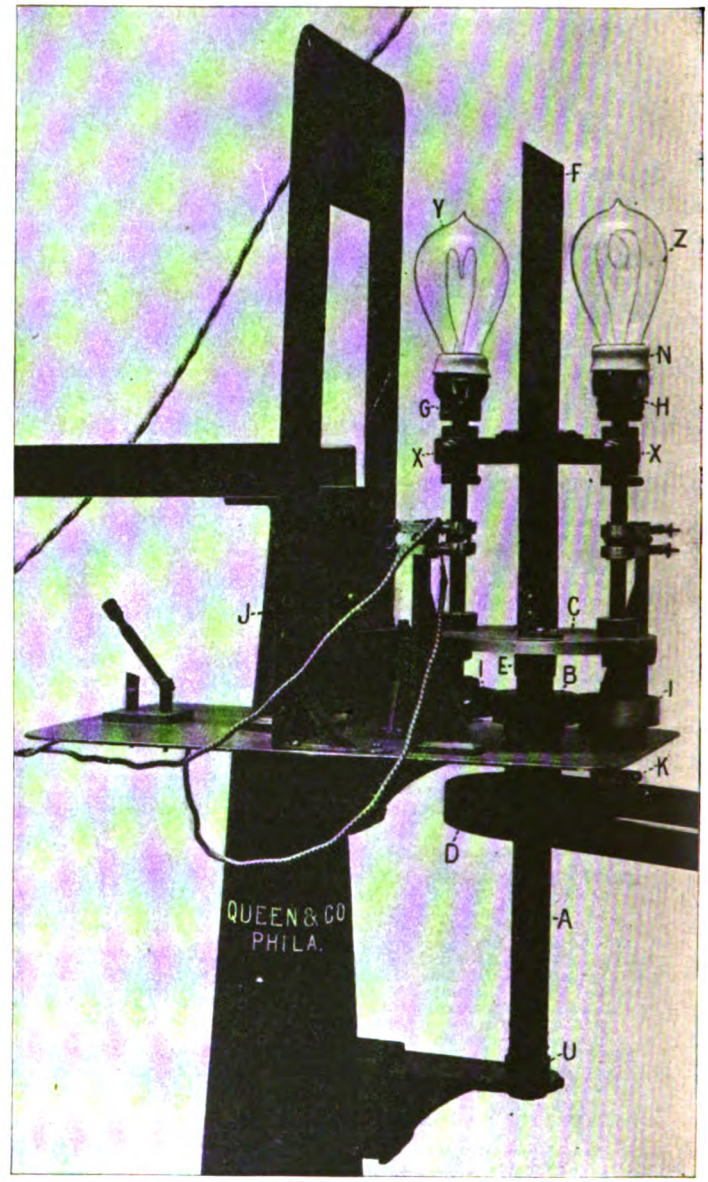

FIG. 2.—PHOTOMETER FOR FOSTORIA LAMP CO.

pedestal of iron carrying a stage, screen and curtain, and supporting one end of the photometer car. An adjustable lamp support on the stage holds a secondary standard, a 16-candle power incandescent lamp. This is standardized by comparison with a pair of certified lamps furnished with the photometer.

The pedestal on the right supports the other end of the photometer bar and carries a screen and an automatic rotating socket. The photometer bar carries a metal scale graduated in inverse squares and having the 16 point centrally located. By this arrangement the photometer reads directly in candles when using a 16 c. p. standard.

The scale is inclined from the vertical so as to be illuminated by the test lamp and render the graduations legible.

The photometer carriage illustrated has a screen of the Lummer-Brodhun type, an optical screen of great accuracy. When so desired either a Bunsen or Leeson screen may be substituted. The two rheostats below the photometer bar are for controlling the potential on the standard and test lamps respectively. They have each about 900 steps, and permit of so small a variation of the candle power or potential as to be imperceptible on the most sensitive voltmeter.

The rotating socket supported by the right pedestal is more

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clearly shown in Fig. 2. The main driving shaft, A, is hollow and journaled in a step, U. It has attached to it a pulley, D, driven from some power shaft and a friction driving pulley, B. This shaft runs at 180 revolutions per minute. Within this shaft is a central one, E, carrying a plate, C, and the screen, F. Upon the plate, C, are mounted two rotating sockets, G, H. They have journals swung from the centres at X, and adjustable boxes at the bottom. Spring plugs keep a suitable pressure between the friction pulleys, B, I and I. Collecting rings and brushes carry the current to the lamp.

At J is a lever which engages in the plate, C, preventing it from moving. Under this condition, the main shaft, A, which is continually rotating, will cause both lamps to revolve about their own axes at 180 revolutions per minute. If, however, the lever, J, is momentarily released, the lamps will revolve about the axis of the main shaft and one replace the other. At K is a release which attaches to a pedal below. Depressing this throws over the shaft of the rotating socket which happens to be there, releasing the pulley, I, from the driving pulley, and at the same time stopping the lamp.

The operation is as follows: When the operator at the photometer has tested the lamp, Y, the operator at the socket trips the lever, J, and the lamps exchange places. In so doing they exchange brushes, and therefore circuits. This construction is to permit of having lamp at Y on normal voltage, and lamp at Z on low voltage. By this arrangement the operator in adjusting lamp at Z is not annoyed by a strong light. After exchanging the lamps the operator depresses the pedal, and by means of the release, K, stops lamp, Z. It is then removed and another substituted. Releasing the pedal starts the lamp rotating slowly or quickly, as may be desired. If not running truly, it may be pressed to one side, and it will stay where it is placed. This is accomplished by using a special socket, N. It is adapted to take lamps without base, and has fluted contacts to secure a proper adjustment of the lamp terminals. When the lamp runs truly, the lever, J, may be tripped, exchanging the positions of the two lamps as before. It will be seen that the apparatus is well made, serviceable and quite automatic, enabling lamps to be tested with the greatest accuracy and facility.

The Becker-Brainard Consolidation.

The Brainard Milling Machine Company of Hyde Park, Mass., and the Becker Mfg. Company of Fitchburg, Mass., have consolidated under the name of the Becker-Brainard Milling Machine Company. The new company are organized with a capital of $500,000. The new company's works will be located at Hyde Park, Mass. John Becker is to be mechanical superintendent. Amos H. Brainard, of the Brainard Company, will be the president of the concern. The consolidation is said to have been brought about by E. N. Foss, of the B. F. Sturtevant Company, Boston, and it is said that he will be an important factor in the development of plans for the extension of the business.

Mr. John Becker, the superintendent of the Becker-Brainard Milling Machine Company, is well-known as the designer and builder of the Becker upright milling machines. The Becker-Brainard Milling Machine Company will manufacture the 50 styles of milling machines as built by the old Brainard Company, as well as the various modifications of the upright milling machine as placed on the market by the Becker Mfg. Company. Both the Brainard and the Becker milling machines have been extensively sold in Europe and have gained a reputation at home and abroad that will make the present combination one of considerable influence in the machine tool trade.

Western Electrical Supply Co.

The Western Electrical Supply Co., of St. Louis, Mo., have recently made arrangements with one of the most prominent telephone manufacturers in the country, for the manufacture of a strictly high grade bell of special design and construction, to be made exclusively for their trade, and in the future all of their high grade telephones will be mounted with these bells. They are in a position to furnish this strictly high grade bell in either bridging or series separate from the instrument, when so desired, at only a minimum cost. These bells are all made with a long hook, with excellent german silver contacts and of the most modern design. Other features are broad noiseless gearing, automatic shunt and fine magnets, all nickel-plated throughout, making it one of the most complete and beautiful bells on the market, with a very strong output of current.

Pelton Engineering Co.

The Pelton Engineering Company, Cleveland, O., has leased the property at 1076 Hamilton street, now occupied by the Parish & Bingham Co., and will take possession on April 1. They will at that time have under one roof probably the most complete electrical supply and repair house to be found in the Central States. They are exclusive agents for the Eddy Electric Mfg. Co., Sheeffer meters and transformers and have several lines of station supplies, brushes, etc. They have just completed arrangements whereby they will put out an incandescent lamp bearing their own label, and have secured a lamp on which they can not only make good prices, but they can also guarantee each lamp. They have at the present time an exceptionally large stock of supplies, second-hand machinery, etc., and are in position to make prompt shipments and to warrant every article they send out.

Paris Branch of E. B. Meyrowitz.

The frequent demand for goods abroad manufactured by E. B. Meyrowitz has induced him to open a branch store in Paris, France, for the sale of optical goods as well as electrical appliances, which will be placed on the market shortly. The branch is in charge of E. C. Bull, formerly connected with the New York (Twenty-third street) office.

"New Standard" Necktie Pin Outfit.

The accompanying illustration shows an electric necktie pin, a novelty which William Roche, 259 Greenwich street, New York, is now putting on the market. The pin itself, it will be noted, contains a miniature lamp, which it is claimed is the smallest used for any purpose and the dry cell is one of the "Standard" make. The pin is a beautiful crystal-studded gilt

"NEW STANDARD" NECKTIE PIN OUTFIT.

horseshoe and operated with a dry cell, vest pocket type, 3½x1½ x1⅛ inches. Being a dry battery, of course, there is no danger of any acid soiling the clothes. This pin with outfit will be mailed by the manufacturer to any address on receipt of one dollar. A large discount is allowed to dealers if the pins are ordered in quantities.

Starting Single Phase Motors Under Load.

Since the advent of the successful form of single-phase alternating current power motor built by the Wagner Electric Manufacturing Company, of St. Louis, a great many inquiries have been made as to just what these motors could do in the way of starting under load. In reply to a direct question upon this point the Wagner Company advises as follows: "We can best answer your question by quoting the following paragraph from a very full report made by some of the engineering students of the University of Nebraska, to Prof. R. B. Owens, this report being based on an exhaustive series of tests extending over a period of several months:"

The best form of day load is evidently some kind of load where current is furnished for power purposes, but since no practical single-phase motors have hitherto been brought on the market, this was not available. Within the last year, however, a series of motors designed to fill this want has been brought out by the Wagner Electric Manufacturing Company, of St. Louis, Mo. These motors are of the self-starting, single-phase induction type,

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designed so as not to cause fluctuations of line pressure so disastrous to lighting circuits, which are caused by the use of synchronous motors. This motor seems to be thoroughly successful where both lights and power are required from the same circuit. It does not affect lights, as will be shown later, and is able to start under a heavy load. The starting torque of the motor is very satisfactory. We have been unable to obtain any very definite results since we did not have enough transformers at our command, but we have ascertained that the motor is able to pull up from standstill more than 50 per cent. overload with not excessive increase over full load current.

PHILADELPHIA NOTES

THE WARREN-WEBSTER CO. have recently installed their Webster system of steam heating in the following places: Creedmore Mining Co., Creede, Colo.; Ohio State Capitol Annex, Columbus, Ohio; Washington County Court House, Washington, Pa.; steel pier, Atlantic City, N. J.; St. George's Hotel, Evansville, Ind.; P. R. R. ferry, Jersey City Terminal, N. J.; J. G. Brill Co., Philadelphia, Pa.; Pa. Institute for In. o' Blind, Overbrook, Pa.; Toronto Carpet Co., Toronto, Canada; Fraser & Chalmers, Chicago, Ill.; Elgin National Watch Co., Elgin, Ill.; Reliance Building, St. Louis, Mo.; Dental Snuff Mill, Lynchburg, Va.; West End Trust and Safe Deposit Co., Philadelphia, Pa.; Penobscot Chemical Fibre Co., Great Works, Me.; Consolidated Fruit Jar Co., New Brunswick, N. J.; St. Louis Club, St. Louis, Mo.; Indiana State University, Bloomington, Ind.; N. Y., N. H. & H. R. R. Co. Depot, Providence, R. I.; Nonotuck Paper Co., Holyoke, Mass.; Self-Winding Clock Co., Brooklyn, N. Y.; Columbia Flats, Washington, D. C.; Cleveland Twist Drill Co., Cleveland, Ohio; Masonic Temple, Boston, Mass.; Arapahoe County Poor Farm, Denver, Colo.; W. J. Matherson, Long Island City, N. Y.; F. C. Bosler, Carlisle, Pa.; C., B. & Q. R. R. Co.'s shops, Creston, Iowa; Winchester Repeating Arms Co., New Haven, Conn.; Hochelaga Mills, Montreal, Canada; Winship Machine Co., Atlanta, Ga.; State Capitol, Harrisburg, Pa.; J. R. Keim & Co., Philadelphia, Pa.; Burgess Sulphite Fiber Co., Berlin, N. H.; Press Building, Philadelphia, Pa.; Jarvis Paper Co., West Claremont, N. H.; Morris Building Co., Mill No. 3, Brooklyn, N. Y.; Monarch Rubber Co., Campello, Mass.; Worcester County Court House, Worcester, Mass.; Corey Heller Factory, Forest Hill, N. J.; Noll & Williams, Louisville, Ky.; Mass. Cotton Mills, Lowell, Mass.; Hazard Mfg. Co., Wilkesbarre, Pa.; Heywood Bros. & Wakefield Co., New York City; Museum of Science and Art, Univ. of Pa., Philadelphia, Pa.; U. G. I. Co.'s Building, Philadelphia, Pa.

THE ELECTRIC STORAGE BATTERY CO. This important and progressive company has, it is said, passed into the stock control of the Whitney-Widener-Elkins syndicate, now doing so much electrical work and buying therefore so many battery plants of great size. The total capitalization is understood to be about $13,500,000.

NEW YORK NOTES

MR. LEO T. LEVY, who is well-known to the trade as the Eastern representative of the Wheeler Reflector Co., Boston, Mass., and the Chicago Fuse Wire Co., has recently obtained the sole agency for Massachusetts, Rhode Island, New Hampshire, Maine, District of Columbia and Maryland for the Stevens' flush switches, manufactured by the Electric Protection Co., Philadelphia, Pa. The many advantages possessed by these switches are well-known and their popularity will be ably expounded by Mr. Levy, whose headquarters are at 853 Broadway, New York.

AUGUST BECKER, 34 Oliver street, Boston, reports that the name plate business is very good and that they are making big lots of that specialty.

ATLANTIC MFG. CO. has been formed under the laws of Maine for the manufacture of electrical apparatus with a capital stock of $1,000,000, of which $40,000 is paid in. The incorporators are: C. E. Bibber, H. W. Smith, both of Boston; and C. W. Davis, of Waterville, Me.

WESTERN NOTES

THE WESTERN ELECTRICAL SUPPLY CO., of St. Louis, Mo., have recently secured a large amount of weatherproof wire, which they are offering to the trade at a greatly reduced price. This wire, although not new, has not seen sufficient service to damage it to any extent, and is all put up on reels in first class condition. The sale of this wire, however, does not in any way interfere with the sale of their large and well assorted stock of new wire of the John A. Roebling's Sons Co.'s make, for which they are agents.

ELECTRIC APPLIANCE CO. are calling attention to the fact that it is not too early for the alert station manager to make his preparations for protection from lightning during the early spring storms. There is frequently quite heavy lightning in March, and to be safe, lightning arresters should be installed early in that month.

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The Electrical Engineer.

Vol. XXVII. MARCH 2, 1899. No. 565.

MISCELLANEOUS

The Wehnelt Electrolytic Current Interrupter.

BY PROF. ELIHU THOMSON.

IN response to the suggestion in The Electrical Engineer, the writer made some experiments with the interrupter of Dr. Wehnelt, based upon the description published in the issue of Feb. 16. It is a most interesting and effective device, the acme of simplicity. The results it gives are truly quite remarkable. For the guidance of others some of these are referred to later on.

To construct an interrupter, one needs only a tumbler of battery acid (sp. gr. 1.20), a piece of platinum wire, say, .3 to .5 mm. in diameter and 2 centimetres long, a piece of glass tubing about 10 centimetres long, a piece of sheet lead, say, 3 centimetres wide and 15 centimetres long, with a wire or binding post attached.

The glass tube is drawn down, the platinum wire sealed in so as to project about 1 centimetre, more or less, from the end of the tube. It also projects into the tube and the tube is bent a short distance from its end to a right angle. The mercury is poured in and a wire dipped into the mercury. The lead sheet and the glass tube are then immersed in the acid in the tumbler and the whole is ready for use.

The utility of the mercury is to keep the wire cool within the tube and thereby to prevent cracking at the seal. No mercury is, however, needed, as the connecting wire (or better a cable) may

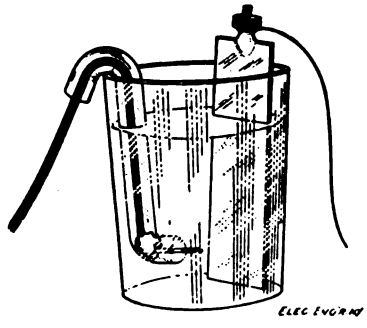

FIG. 1.

be run down the tube so as to touch the platinum, and a few drops of solder then melted in to unite them. The conductivity for heat of the cable, if of fair size, and the mass of the solder, serve the purpose of the mercury, and cannot, of course, be spilled. The sketch, Fig. 1, shows this device in working order. If it is to be worked for a long time it is well to immerse the tumbler in an outer vessel of water to keep the acid cool.

The platinum points and tubes bearing them are so easy of construction that a set of three or more may be provided and hung in the same vessel of acid, and switches provided to change from one to the other or to couple them in multiple opposite the same lead plate cathode. The several platinum points will vary in the particulars of extent of surface exposed to the liquid. One of them may have, for example, a wire of .2 mm. diameter projecting only 1 mm. In another the wire may be somewhat larger and may project from the glass seal 3 mm., etc.

Connecting one of these interrupters in series with a primary of an induction coil, or with several such coils in series connection, the whole being put across the mains of a 110-volt circuit, one witnesses a surprising display. The fierce discharge between the secondary terminals proves not only the rapidity but the sharpness of the interruptions. If the secondary terminals be not too far apart the discharges form a flaming arc, accompanied by a loud note, not altogether musical, but indicating a definite pitch. With the terminals farther apart this may be replaced by a torrent of sparks, and when they are still further apart the terminal wires are aglow with blue discharges.

Putting the usual jar condensers on a coil which normally gives a torrent of sparks seven inches in length, causes shortening of the spark distance as in ordinary cases, but the effect becomes terrific. The noise is deafening and the white stream of condenser sparks lights up all the objects around with a continuous intense whitish blue light.

The secondary discharges tend to a unidirectional character when the spark length is such that individual discharges or sparks are obtained at each interruption without jars or condensers,

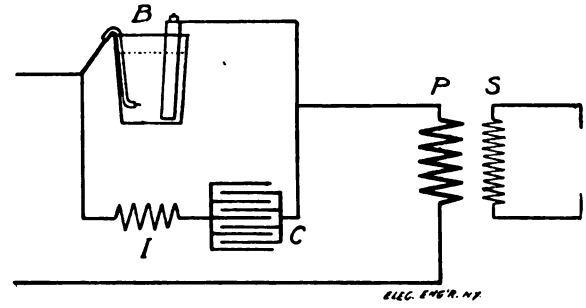

FIG. 2.

but the arc when formed between the terminals is doubtless an alternating discharge, at least in part.

The interruptions are very sudden, while the increase of the primary current after each interruption is dependent largely on the inductance of its circuit. The rate of change is therefore greatest at the breaks, and the secondary voltage correspondingly greater when the breaks or interruptions occur than when the current is rising in the primary.

As pointed out by Dr. Wehnelt, the interruption of current occurs upon the attainment of a certain current density at the platinum anode surface. This attainment of a certain current density is dependent on the time constant of the circuit or upon its inductance. The higher the impressed voltage also, the less the time taken in reaching the limiting or interrupting value of the current.

To increase or decrease the speed of interruptions then we may:

1. Vary the area of platinum wire exposed to the liquid bath.
2. Vary the inductance of the circuit, as, by adding or taking out coils, or by sliding cores within coils, etc.
3. Vary the impressed voltage.

If we lessen the platinum area, the rate of interruption rises accordingly, because with other conditions the same it takes less time for the current to reach the then smaller limit of value.

If we increase the inductance greatly the interruptions may be brought down to but 10 or 12 per second, or probably far lower than that. On the other hand, a wire core with a few turns of copper wound around it may give an inductance so low as to result in enormous speeds of interruption.

Indeed it is not at all difficult to attain speeds which, judged

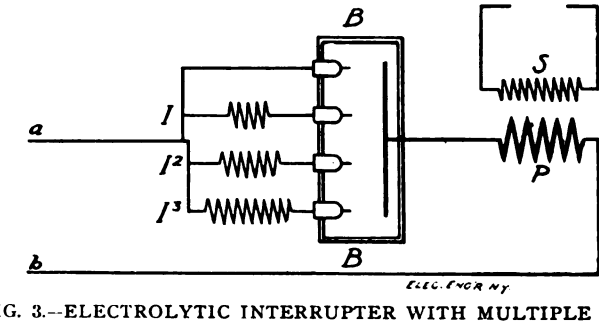

FIG. 3.--ELECTROLYTIC INTERRUPTER WITH MULTIPLE TERMINALS OF VARYING IMPEDANCE.

by the pitch of the sound evolved are of the order of thousands per second. In such case an induction coil behaves very much like a high frequency apparatus, and may be made more like it by shunting the interrupter itself with a condenser, with but a slight inductance in series therewith.

This combination is indicated in Fig. 2, where B is the inter-

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rupter, I the inductance, C the capacity (condenser), P the primary, S the secondary, at the terminals of which high frequency effects are to be produced.

At the highest rates of interruption the rates of change at make and break become more nearly alike and the induction coil secondary then emits alternating discharges.

A curious feature of these experiments should be here mentioned. When the secondary arc discharge forms, the note rises or the interruptions become more rapid. This is, of course, as it should be, since the primary current then reaches the limiting value for the interruptor in less time. When the secondary of the coil is open (terminals too far apart), a very loud noise is made in the interrupter and the vigor of its action in stopping the current indicates, so to speak, a struggle. This sound largely disappears and there is less commotion in the liquid around the platinum when the secondary coil circuit is either closed or emitting its discharges.

During action the platinum wire in the interrupter is surrounded by a pinkish-yellow glow, not over bright. Numerous bubbles, of oxygen gas, are thrown violently out from it and the effect, noise, etc., suggest the escape of steam containing a little air from a pipe immersed in a vat of cold water. The liquid and the bubbles around the platinum wire are in vigorous rhythmic movement. The following explanation is suggested tentatively:

On the attainment of a certain current density the wire becomes a veritable positive crater as in an arc, or at least the layer of electrolyte in close contact with the wire is so highly

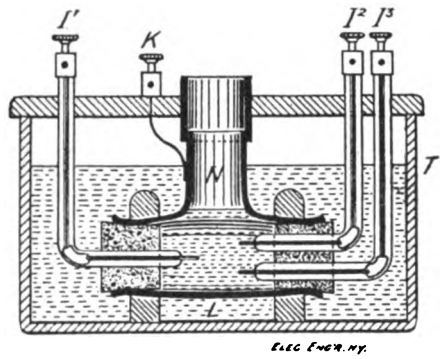

FIG. 4.—ELECTROLYTIC INTERRUPTER WITH MULTIPLE TERMINALS.

heated as to become disassociated into oxygen and hydrogen, with oxygen in excess from electrolysis. This layer insulates the wire as with a covering, stops the current, the gases reunite with explosion, casting out the excess of oxygen in bubbles, the liquid touches the wire again and the process is repeated indefinitely. This would explain why a certain current density as a limiting value must be attained at the platinum surface before the phenomenon can begin.

If the resistance in the circuit is so great that this limiting value cannot be attained, the interruptions do not take place.

Curiously enough, two of these interrupting platinum anodes may be worked in parallel and the effect is that the interruptions then occur only upon the attainment of a higher current value in the circuit. Whether this value will be the sum of the limiting values for each interrupter is not determined. The running of interrupters in parallel suggests the provision of a set having values of 5, 2, 1, as in a set of weights, so that by switching in parallel or using one or the other single, any value in units from 1 to 10 might be obtained.

It is to be doubted, however, that the interruptions will be so sharp with this form as with a single interrupter. Trials made with those at hand seem to indicate this as a fact. This doubt can be settled by further experiment.

Fig. 3 shows another suggestive arrangement. Let B be an electrolytic interrupter having four platinum points immersed. One of these is connected direct to a; another through an inductance I; a third through inductance I^2, and the fourth through inductance I^3. Here there will be four rates of interruption of the primary P, rates which can be adjusted by taking advantage of the facts above pointed out. The secondary spark at S can thus probably be made to sing in chords, or discords, as the case may be. Here, also, as will be seen, we have the elements of a somewhat novel and striking electrical musical instrument, as we may provide many interrupters tuned to the notes of the musical scale, each interrupter controlled by a key or otherwise. How musical it can be made to be, however, is doubtful. The notes given out have a harsh, strident quality, and such waves would need considerable smoothing out to render them acceptable even to the untrained ear.

The excitation of a Röntgen ray tube by a coil worked by the Wehnelt interrupter, is, of course, a great field of usefulness. No condensers are needed and they are not even useful except for special effects, as above pointed out.

The rate of interruption may be made low or high as desired, and the apparatus is exceedingly simple and surprisingly regular. But the ordinary tubes can not survive the energy given by the interrupter. Smaller coils can, however, be used.

There is in fact great danger of melting down the platinum anticathode, and a hole may be put through it in less than two seconds' passage of current. A platinum target 5/8 inch diameter and 1-16 inch thick is made white hot in a few seconds.

Need it be said, however, that the intensity of the rays is very great? The writer's experiments convince him that the rates and energy can be so adjusted as to give a remarkably steady emission of rays resembling that obtained with a large static machine, and that the brilliance of the effects on the fluorescent screen are such as he has only seen with the selector exciter devised by Mr. Hermann Lemp some two years ago and used at the laboratory of the Thomson-Houston Co. in Lynn.

The response of the electrolytic interrupter to the closure of the circuit is so instantaneous as to be of value in certain kinds of work. Thus, in taking X-ray pictures of the chest, the closure of the circuit can be timed with the breathing movements of the chest so as to have the ribs at the same position when the rays pass; or the breathing movement itself can actually be made to open and close the switch, to the same end. In Hertzian wave telegraphy the signals can be made by a key in the interrupter circuit, the response being immediate, and when the key is left open there is no loss and no wear and tear.

This account of the personal experience of the writer with the most interesting device of Dr. Wehnelt may be closed, at least for the present, by a description of a multiple interrupter of simple construction utilizing the principle brought forward.

Referring to Fig. 4, T is a tank containing water for cooling; L is a leaden tee with neck N extending upward for escape of gases; C, C, are rubber stoppers closing the ends of the pipe L or leaden tee. Through these stoppers project a variety of platinum point interrupters whose terminals are at I^1, I^2, I^3, etc. These varying surfaces of platinum are exposed to the acid in L. The cathode is the lead L and terminal at K. This form is suggested on account of the facility it affords for cooling, an important matter when heavy currents are used. When the acid liquid gets hot or near boiling it fails to act. The interrupter necessarily consumes energy which is evidenced by the glow around the platinum and the energetic action in the liquid as well as by the noise produced. Still its working is so admirable that the waste of energy can well be supported.

Lynn, Mass., Feb. 20, 1899.

An Experimenter's Satisfactory Results with the Wehnelt Interrupter.

THE following interesting communication has reached us from a correspondent in Scranton, Pa.:

"In The Electrical Engineer of February 16, there was described and illustrated a new form of interrupter. I tried the scheme roughly, but got astonishing results. The discharge of rays was steadier and of greater volume than I have ever seen before. The interruptions were so extremely rapid that the mechanical vibrator on the coil failed to respond when connected in series with the primary. A slight tremor was visible in the spring, but the contact points were not separated. The rate of interruptions increased with an increase of the applied e. m. f., and with a gap of 3 inches in parallel with the tube, sufficed to excite the tube in a measure that I have never before witnessed."

Cracking Safes by Electricity.

A special despatch from Oberlin, O., of February 17, says that cracksmen connected to the trolley wire and with its current drilled the safe door of the Oberlin Bank, then blowing it open with dynamite. Secretary Beckwith, of the local trolley company, wires us that there is no truth in the report.

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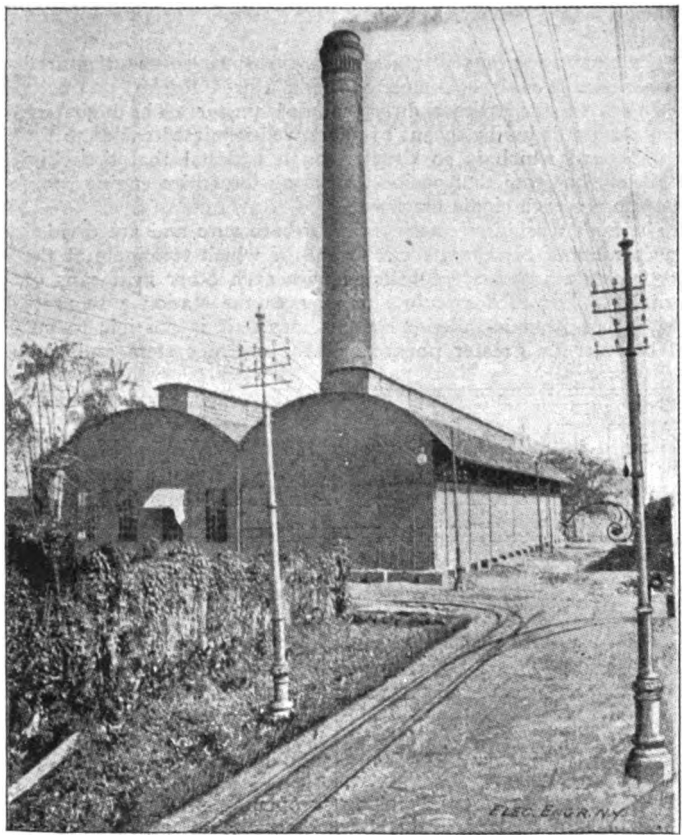
ELECTRIC LIGHTING.

Electric Light and Power Plant at Para, Brazil.

ON the right bank of the Rio Guajara is situated the capital of the Brazilian State Para, the city of San Maria de Belem, officially known as Belem, but commonly as Para. The entire wide delta of the rivers Rio Tocantins, Rio Guajara and Rio Amazonas, which here empty into the ocean, is geographically known as the mouth of the king of rivers, the Amazon. Numerous canals flow through this otherwise thickly wooded



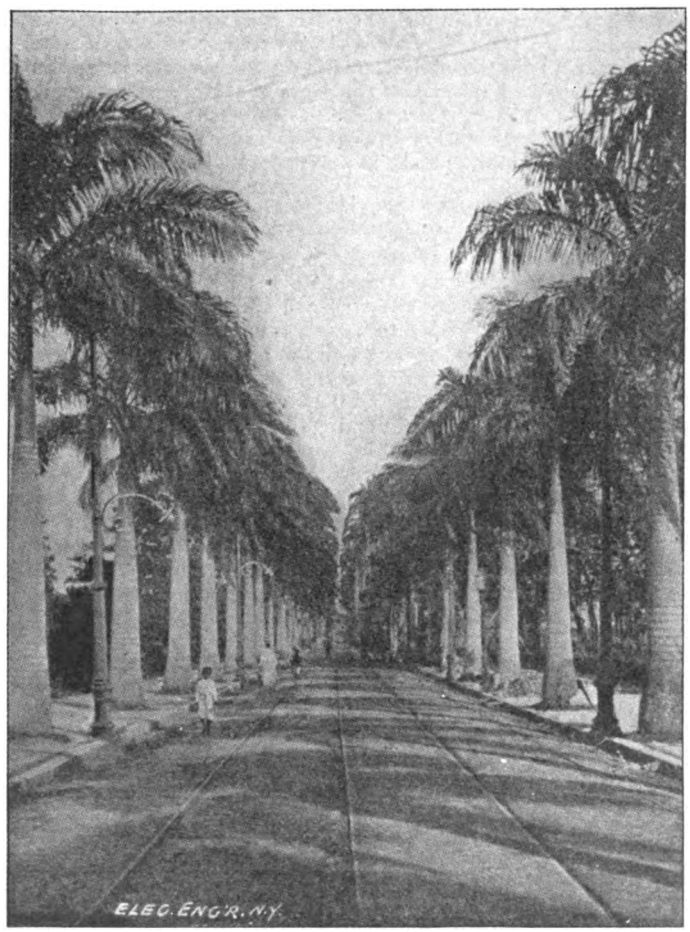
POWER HOUSE, PARA, BRAZIL.

country, whose capital, Para, forms the exclusive centre of commerce between the interior country and the North American and European harbors and has thus risen into considerable prominence. At this point many foreign industrial products are imported, while para nuts, tobacco and principally rubber which is obtained in large quantities and of good quality from the surrounding forests form the principal export articles. Due to the enormous extension of the rubber industry, rubber having found extensive application in engineering and for electrical apparatus, and principally in the tire industry, Para has risen to-day to a rich, and, according to Brazilian ideas, a very elegant city.

The depressing or tiring influence which the tropical damp climate exercises on the native population is responsible for the dislike of the Brazilian for physical exertion. For many years, therefore, the city's population has made extensive use of the street railroads. A very substantial network of roads spreads over Para in all directions, and the cheapness of transportation is taken advantage of very largely by the inhabitants. The car line formerly run by mules belongs to the Companhia Urbana de Estrade de Ferro Paraense. This company also supply lights to the city of Para. They gave a contract some time ago to the Siemens & Halske Company for the construction of an electric generating plant to be used for lighting as well as furnishing current for a proposed electric street railway system, and for sale to private consumers. The construction of the plant was connected with a number of serious difficulties. The ground formation, the tropical climate, as well as the utter unfitness of the native population for construction work, required a vast amount of patience, perseverance and energy. The work, however, has finally been completed and the following is a description of it, as well as the road which it supplies with current.

The piece of property situated on the bank of the Rio Guajara which had been selected for the location of the power house was thickly covered with palms and shrubbery and was typical of the land within the delta territory. After the water had been drawn off, enough earth was dumped on the selected site so that it would remain dry at high water and be continually exposed to the sun. Finally, solid foundations had to be built for the boilers, machinery, and, above all, the chimney. To this end piles twelve to fifteen metres in length, and from thirty to thirty-five centimeters in diameter were driven, which were obtained from the nearby woods. These piles were driven close to each other, and it happened that in several places they entered the ground without any driving force being required, the mere weight of the 400-kilogram hammer being sufficient. In order to gain solid ground a second row of piles had to be driven on top of the first, and above this the foundations were built.

The power house, shown in the figure, is a building constructed entirely of iron. It consists of two adjacent portions of thirteen and eleven meters width respectively, and each fifteen meters in length. The height up to the edge of the roof is seven meters. The surrounding as well as the dividing walls consist of structural iron covered by heavy galvanized iron sheets. Between the two portions of the building a gutter is provided. Rolling doors permit entrance to the building, while hinge doors are situated in the dividing walls. Skylights, provided also with means for ventilation, which can be operated from below, are located on the roof. The side-wall trusses of the larger building have been selected sufficiently strong to serve as a support for a ten thou-



AVENUE SHOWING CAR LINE, POLES, LAMP BRACKETS, ETC.

sand kilogram crane. One-half of the building, as seen in the plan, serves as a boiler house, and located next to it is a small workshop, laboratory, store room for the parts and the engineers' compartment. In the other half are located the engines, generators and switchboard, as well as the auxiliary apparatus.

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The chimney is located in the centre of the building in such a way that it divides the boiler house into two portions. The height of the chimney is 45 meters and the diameter at the top is 2.86 meters. An enlargement of the plant can be made at any time in a simple manner by building an addition at either or both ends of the building. The boiler room contains at the present time three water tube boilers of the Steinmiller pattern, each of 242 square meter heating surface, and built for a pressure of twelve atmospheres. The boilers are intended to burn wood fuel, but are equipped with automatic stoking apparatus for coal firing on the Leach system. The other half of the boiler room is reserved for boilers of the same size as those mentioned above, while the entire half of the other building is reserved for a later extension of the plant. Although the plant is situated close to the river and very near the woods, the transportation of serviceable firing wood was connected with so many difficulties and became so expensive that the management finally decided not to use wood firing at all. This may seem very strange to those not on the spot or acquainted with the conditions, namely the high prices that have to be paid for labor and also the entire absence outside of the city of roads for the transportation of material, as well as of the simplest means of transportation. It was necessary for the laborers to carry each piece of wood on their backs through the woods to the nearest tributary of the river in order to transport it from there in small boats to the city. Under all the various circumstances it was considered advisable and more profitable to transport coal from England by means of sailing vessels.

In the boiler house are the following apparatus: A coal conveyor, which has an hourly capacity of 2,500 kilograms, as well as a steam engine of 8 h. p. for operating this coal conveyor and the Leach apparatus. Also the transmitting apparatus for these, and two horizontal steam pumps for pumping the feed water for the boilers.

The steam pipes are, in order to effect the most economical arrangement, very short, and to a large extent placed under the floor. In laying out the main steam piping, the probable extension in future years was taken into consideration. The water supply for the boilers and for condensation was originally to be obtained directly from the river. For this purpose a well and a filter were built next to the building and the well connected by strong piping with the river. Soon after the plant was started, however, it was found that the estimates regarding the water conditions in the river, which had been made by the company, were not correct. At low water it was found that the water receded further than was originally assumed, and at times no water entered the piping system. The deepening of the well and the laying of the pipes further into the river would have been connected with considerable difficulties originally as the condition of the river bed as well as the very strong river currents would have necessitated a very massive foundation and a strong fastening of the pipes. Further, no reliable statistics could be found regarding the different water levels, the only fact known being that the height of the river varied considerably in the dry season. Changing the location of the pipes therefore would give no absolute security.

The company finally resolved to build a water reservoir of its own. It was designed for a capacity of 1,000 cubic meters of water, sufficient therefore for a six-hour run of the plant when operating at its maximum, which might be expected at any time. The location of this was chosen right behind the well in such a way that the reservoir itself would, with the ordinary height of water, be flooded several hours during the day. During its construction, water was obtained provisionally by a lighter anchored in the river which served as a reservoir, pumping water into the well when the pipe line became empty. Besides, the water which had been used for condensation was cooled in circulating pipes and led back to the well.

The ground was even of a poorer quality than that on which the plant was built and was flooded daily. The protective dams which were built could not be made sufficiently tight; water found its way beneath them, through swampy ground, and was suddenly discovered in the form of a fountain at the place excavated. When it was finally half finished after a great number of trials and tribulations, the river suddenly rose to an extraordinary height, the protective dam was swept away by the force of the rushing water and the excavation entirely filled up. Only after the overcoming of enormous difficulties was it possible to make the excavation and to finally lay the foundation.

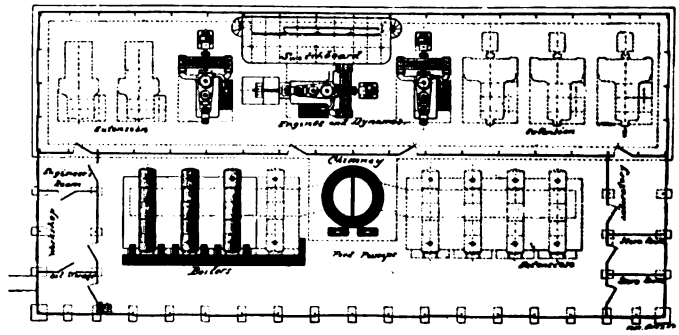
The machinery room, like the boiler room in the first extension, is only partially used. In it are located two triple expansion steam engines with condensers each directly connected to a generator. Each of these steam engines has a capacity of 300 h. p., an admission pressure of 11 atmospheres, a speed of 150 r. p. m., and the steam cylinders transmit their effort to one shaft driven by three cranks placed at angles of 120 degrees from each other. The shaft revolves in heavy bearings and is extended at the dynamo end.

Means are provided which allow the speed to be varied by hand or electric motor as much as 10 per cent. The condensing apparatus is located below the engine room floor. As reserve, another triple expansion steam engine has been installed of the same size and style as the other two, with this exception—that the shaft is extended at both ends and is supported at those ends by two extension bearings.

This reserve machine is intended to drive, besides the already installed alternating current machine, at the other end of the shaft a continuous current dynamo so that it may serve simultaneously as a reserve for the current supply for traction and lighting.

The alternating current machines are of the type manufactured by Siemens & Halske Company, giving a pressure of 2,000 volts and each supplied with a direct coupled exciter. The high tension current is led by means of short well-insulated cables to the switchboard which is so situated on a pedestal that the chief engineer can from that position overlook the entire engine room and can see each single machine.

The high tension circuits consist of bare wire and are divided into a number of separate circuits all of which terminate at the central station and are connected with each other by means of switches. For each circuit which leaves the station a separate switch has been installed. By this means it is possible to cut out smaller or greater portions of the entire system and also



PLAN OF PARA POWER PLANT.

control them directly from the central station. Furthermore, different combinations of the separate circuits can be effected with ease by means of the closing or opening of the switches.

On the switchboard, right above the switches, is a board on which by means of different colors and easily distinguishable pointers the instantaneous disposition of the circuits can be ascertained and the switches in the station as well as the points of distribution in the network are marked in an unmistakable manner. This enables the chief engineer, in case there should be a break anywhere on the line, to immediately locate the same and make his necessary measurements. He is also able to equalize differences of pressure should these be found in the different parts of the lighting system.

The above described method is of special interest and importance, because the conditions in Para, like those in most tropical cities, give rise to many and various kinds of interruptions of service such as cannot be found in other countries with better and more civilized regulations. For example, in the extraordinarily narrow streets, in which two wagons cannot even pass each other, it is necessary to support the wire on brackets attached to the buildings. Regardless of all warnings as to the dangers of the currents the natives insisted upon disturbing the wires by means of scaffolds in the most reckless manner. Besides, the large palms and the mango trees, shown in the cuts, as well as the almost daily thunder storms were continuous dangers, while the telephone wires which were supported after the American fashion on glass insulators mounted on cross arms and fastened by means of two nails to a pole, tree, or a wall, in any manner whatsoever above the high tension wires, fell down very frequently and caused disturbances. Finally, the absolutely useless police force did not attempt to put a stop to, and rather encouraged, the mean practices of the lower class of people. As a

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characteristic example of this may be mentioned the death of a man by means of a 120-volt alternating current which was caused through a so-called joke. At a certain place near the wharf where the wires delivering current for only a small number of lamps pass, several mulattoes were occupied with the unloading of cotton, the bales of which were placed on top of each other so as to nearly reach the wires. One of the workmen climbed up and touched the wire with his hand. In the meantime the others began to tease him and amused themselves over the small electric shocks which they received by touching him. Suddenly the workman on the bales touched the wire with both hands, was at once seized with cramps, and remained hanging on the wires. Vainly his comrades tried to tear the unfortunate man off, and in the attempt one of them fell down from the high steeple of bales and hurt himself on the head. The unfortunate mulatto however, remained in the hanging position until the fuse on the circuit had burned out. He then fell down, but was dead. Attempts to revive him of course were useless and were only made after several hours had elapsed since the accident, and men at the central station had been notified. The chief engineer did not even notice the short circuit at the switchboard.

The transformer equipment for the reduction of pressure from 2,000 to 120 volts is very varied. The transformers which are used for the street lighting circuits are placed on iron pillars shown in the figure and which are sufficiently high so that wires at the ordinary height can be led directly into them. They are covered by means of canopies to keep out the rain and are enclosed by iron cases so that they can be kept outdoors. The transformers for private lighting are installed in the houses themselves and are protected by wooden cases built around them. They are nearly all of the smaller types and the attempt was made to group these installations as much as possible.

During the heavy thunder storms which occur throughout the entire year many heavy lightning strokes disturbed the line, but the Siemens & Halske lightning arresters proved very efficient in protecting the transformers and machinery against any harm.

The street lighting consists at the present time of about 90 arcs and 1,800 incandescent lamps of 16 and 25 c. p. each, while the private lighting amounts to 4,000 16 c. p. incandescent lights, so that two machines are at the present time taxed to their maximum.

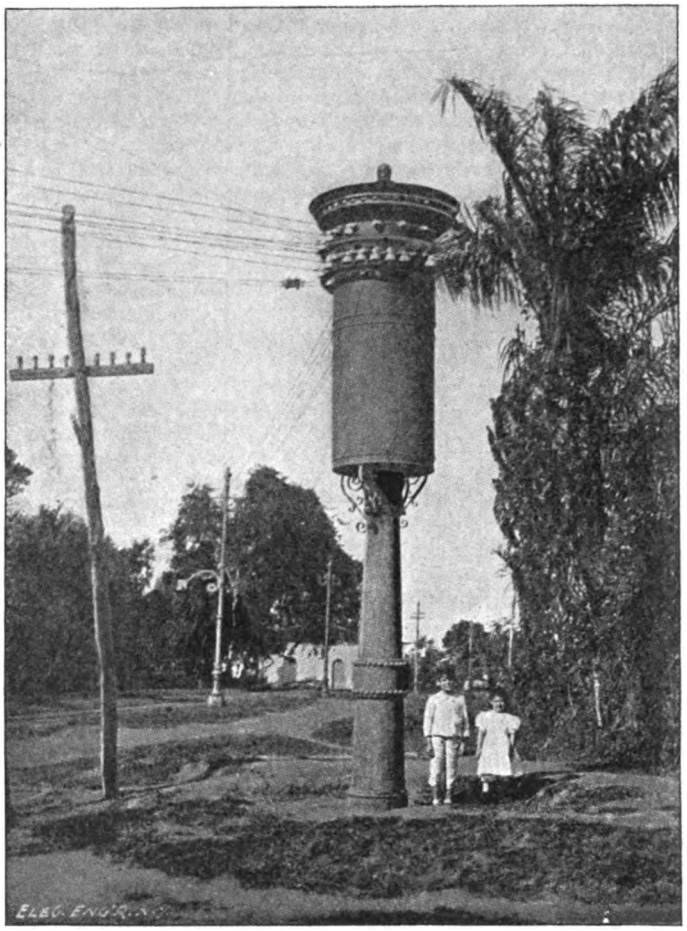
Arc lamps are used for the lighting of squares as well as for several wide streets. The latter have only been laid out recently and are flanked on both sides by large mango trees, the tops of which overhang the road. The posts are placed between the trees on a line with them and the lamps hang over the middle of the street as shown in the figure. For the lighting of squares, ornamental posts are used with brackets on one side only, but on the Largo da Polpora, which terminates in a kind of a boulevard, the lamps are hung between two poles over the middle of the road.

In order to facilitate the distribution it was tried to equip a portion of the arc lamps with single transformers and to insert these small transformers in the base of the posts. It was soon found, however, that the bases of these metal poles became so extremely hot from the sun that the insulation of the coils soon became useless. At the present time the lamps burn in groups of two and three in series.

The great amount of moisture in the air quickly rusts all iron and steel parts, especially during the rainy season. It just happened that the opening of the system fell in this season, and the native help not understanding the care of the arc lamps, many difficulties were experienced at the beginning in keeping the lamps burning. Now, however, these have been overcome, as most of the parts of the lamps exposed to the weather have been constructed of non-oxidizable metal and all the coils have received an extra coating of varnish. Besides, the help has been instructed to clean the lamps thoroughly in the workshop during the rainy season at stated intervals.

The incandescent lamps are fastened by means of handsome brackets to hollow iron poles which not only serve as supporters for the electric light wires but also carry those required for the operation of the road. They are so placed that alternate ones point toward different sides of the street. The current is led to these lamps by wires running through a curved tube which is filled with an insulating mass. For this purpose, however, the ordinary material could not be used as it would not withstand the heat and would melt and run around the protecting glass covers on the lamps. In the narrower streets in the interior portion of the city, the poles are placed on either side of the street, according to the desire of the authorities, and are located 15 to 30 meters apart. In several streets on the outskirts of the city, however, which are still unpaved, and consist of small houses covered with palm leaves, only one row of lamps has been placed in the middle of the street.

The question of help is a very serious one in the city of Para. European machinists and motormen demand a very high salary, as, for fear of yellow fever, they go unwillingly to Brazil. The natives, on the other hand, are regarded as absolutely unfit for regular service. They are used to doing everything in a slip-shod fashion and cannot get used to discipline. The Brazilian laziness always comes to light and even in cases when energetic action seems almost imperative the Brazilian prefers to act in accordance with his favored maxim: "Tem paciencia espere ate amanha"—"Have patience, wait till to-morrow." Soon after the opening of the plant, the very efficient engineer, Hiller, who had gone over from Germany, died from yellow fever. Not being able to find someone to take his place, an Italian marine engineer was employed. He had such a hot-blooded nature that he mortally wounded the assistant engineer, a Brazilian, who was too slow for him, with an iron rod. He himself was placed in prison, and in the meantime the plant had to be run wholly by a number of ignorant colored people who were so jealous of each other that they entered the service with pistols in their hands.



CONVERTER IN STREET.

Regardless of all these difficulties which stood in the way of construction as well as hindered the regular service after the buildings were completed, the plant operates to-day in a perfectly satisfactory manner. The construction and equipment of the plant, which has been planned most carefully to meet local and climatic conditions, may well serve as a good example for and illustration of electrical installations in tropical countries. The above data is from an article by Chr. G. Höst, Berlin, which appeared in the "Elektrotechnische Zeitschrift," Feb. 2, 1899.

BUFFALO is likely to have a Board of Electrical Commissioners to control all electrical work. Niagara is now the Boss of Buffalo, and all must dance to its thunderous music.

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Nernst's Electric Light.[1]

BY JAMES SWINBURNE.

BEFORE describing Nernst's invention, it may be profitable to spend a few minutes reviewing the position of electric lighting. The whole industry is at present controlled by the incandescent lamp. We are so accustomed to this, and it is taken for granted in such an unconscious way, that we do not realize how much everything depends on the maker of the carbon incandescent lamp.

In very early days—that is to say, in the early eighties—there were a few Edison lamps at 100 volts, with an efficiency too horrible to mention, but the Swan lamp came along made for 50 volts. I say made for 50 volts advisedly; I mean that the makers tried to make 50-volt lamps, and produced lamps taking from 40 to 60 volts. If the lamps were not bright enough you ran the engine faster, or put a smaller pulley on the dynamo. (The belt then generally slipped; but that is not to the point.) For about four years, which is a long period in the development of such a rapidly-growing industry as electrical engineering, the makers of incandescent lamps, or, in fact, the makers of the Swan lamp, decreed that the e. m. f. used should be from 40 to 60 volts. There was no appeal. There was no development of central station supply at that time, but still, even then in large buildings, there was the longing for higher pressures on account of the cost of the mains.

About 1885 the Swan 100-volt lamp came into use. It was a clumsy affair with little loops of platinum at the sides. At first the lamps were pretty bad, but they gradually improved, and 100 volts, or in some cases 110 volts, became the recognized pressure for electrical supply.

As town lighting from central stations came into being, the limit of 100 volts became a serious trouble, and the evil was partly mitigated by the use of three or even five-wire systems. I must point out that the incandescent lamp exercises its tyranny in two ways. It not only insists on a low pressure, such as, say, 100, and thus demands large leads to feed it, but it is so sensitive to variations of pressure that the system of distribution has to be arranged to give a practically uniform pressure at the terminal of the lamp. The necessity for uniform pressure probably gives more trouble and costs more than the mere low pressure, and it would be cheaper to supply at 100 volts with a good margin of permissible variation of pressure than supply at 200 with a very small percentage of variation.

Quite lately the incandescent lamp makers have produced things called 200-volt lamps, and some make them for 250 volts. So there is a general tendency on the part of supply companies to jump to a 200-volt supply. The innocent consumer is therefore pressed by the company to change over to 200 volts. The company likes the change very much, and the lamp maker also enjoys it, as he makes more lamps and charges more for them.

Considering the enormous importance of the incandescent lamp, its improvement has received extraordinarily little attention. It limits us as regards pressure, it used to hamper us by its cost, it limits us as to variation of pressure, and it limits us very seriously by its inefficiency. Yet, in spite of these, the carbon incandescent lamp has made practically no advance in 15 years. Of course mere detail improvement in manufacture has taken place, and this has led to better quality and greater uniformity, hence cheapness; but there has been no radical improvement. The jump to 200 volts from 100, or from 50 to 100, did not depend on any sort of radical improvement in the incandescent lamp; it was merely the result of detail improvements making it possible to produce long thin filaments. Other things being equal, it is easy to see that the long thin filaments must be weaker. If the carbon has the same specific resistance, the relation between pressure and length is $E = L^{\frac{2}{3}}$, and $E = D^{\frac{2}{3}}$. If the filaments are flashed, the proportions will be still more extreme. The question of high pressure incandescent lamps is thus, how far can we make the filaments longer and thinner and flimsier without exasperating our consumers? Unfortunately the consumer is rapidly getting saddened as it is. The 100-volt 8-c. p. lamp does not please him much, and the 200-volt 8-c. p. lamp has in no way delighted him; if the lamp is made with two 100-volt filaments in series, it combines the disadvantages of both without the advantages of the small candle power of either. But it adds some further disadvantages peculiar to the higher pressure which I have not so far touched upon—and that is, that the higher the pressure the more troubles there are through the silent discharge, or whatever it is called. I need only refer to the well-known experiment in which a third terminal is sealed into the lamp. A galvanometer then shows a current going across country inside the lamp. This is, no doubt, intimately connected with the life, or rather with the death of the lamp.

I have dealt with the question of high pressure incandescent lamps at some length because the subject is really of vital importance, and is too much neglected. Our technical colleges, and our technical press, and our technical societies pay the greatest attention to questions of a per cent. or two in the efficiencies of dynamos and transformers, and give a good deal of attention to engines and boilers. That is because there is plenty of room for calculations in connection with these subjects, but the incandescent lamp, which at present holds the whole career of the lighting industry in the little curl of flimsy red-hot carbon that can hardly support its own weight, receives no attention at all. How much does the average electrical engineer know about incandescent lamps? The only subject that is treated in the same way is the cable. About half the money in town lighting goes in the cable—a mere fraction in the dynamos and transformers themselves—so the average electrical engineer knows nothing about cables.

So far I have only discussed the incandescent lamp; the arc lamp has also to be considered. I will not say much about the arc lamp just now, but will add a little more when the Nernst lamp is compared with it. The ordinary arc is limited in pressure to about 50 volts, including the series resistances necessary for regulating. The enclosed arc is a new development, which is more satisfactory as regards pressure and as regards consumption of carbon.

The lamp I describe to-night is the invention of Prof. Walther Nernst, of the University of Göttingen. Though he is a young man, Prof. Nernst's name is already known to all modern chemists as a leading authority and original thinker in the field of physical chemistry. It is unusual for a man who has climbed to the top of one tree to jump to the top of another.

Nernst's, like most great inventions, is exceedingly simple as soon as it is understood. The efficiency of an incandescent body, as far as radiation goes, depends simply on the temperature. The efficiency of an incandescent lamp, for instance, depends on the temperature of the filament only, providing there is no loss by convection. The carbon will not stand a sufficiently high temperature, especially as, in addition to its low specific resistance, the filament has to be long and slender, and thus weak. Nernst, therefore, chose a material that would stand higher temperatures than carbon, and his material has the incidental advantage that its specific resistance is so high that strong rods can be used for high pressures instead of thin filaments. The most refractory materials so far used in lighting are zirconia, which has been used to replace lime in the limelight, and the oxides or so-called rare earths, in the Welsbach mantles. I am aware, of course, that many people suppose that the Welsbach mantle is not very hot, treating it as if it were at a temperature, for instance, below the melting point of platinum. The light emitted is supposed to be due to some special power of selective emission due to the oxides employed. I have had a good deal to do with incandescent gas mantles, and I find no reason to suppose there is any magic effect of this sort going on. The part of the flame where the mantles hang fuses platinum wire easily, and very few materials can stand the temperature without fusing or volatilizing. Lime and many other oxides volatilize slowly from the mantles. I do not mean that the mantles are above the boiling point of lime; I have some idea of its melting point, as I have made a few pounds of melted lime and ran it out on the floor to look at it. The Welsbach mantles, which are now chiefly thoria, are at a temperature near their softening point, and in the making are raised to a temperature at which they begin to soften.

Nernst takes highly refractory oxides as his material. It does not seem promising, because such oxides are notoriously good insulators. But such insulators are electrolytes when hot. Nernst, therefore, heats the rods to make them conduct, and then heats them electrically, preserving a temperature which is within the limits that the material can bear without softening. This means that he can take the most refractory bodies supplied by the whole range of chemical research, and can heat them to a temperature short of their softening point, and can thus get an efficiency unknown to workers on the incandescent lamp. Such efficiency also means whiteness of light, so long as the efficiency is not too high. Thus the crater of the arc, being at a temperature of boiling carbon, gives a light that is unpleasantly blue.

The material is worked up into little white rods. Each rod

[1] Paper read before the Society of Arts, London, Feb. 8, 1889.

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is mounted on two platinum wires, a little paste made of refractory oxides being applied to the joints. The little rod with its two wires is then mounted on a holder which fits ordinary electric light fittings. As the rods fall in resistance as the temperature increases, after the manner of electrolytes, an increase of current produces a decrease of resistance. This tends to give some instability in running in parallel on supply circuits. This instability is corrected, as in an arc lamp, which has analogous properties, due to a different cause, by a series resistance. The Nernst rod has therefore a resistance in series. This is made up of exceedingly fine wire, and for ordinary circuits amounts to 10 or 12 per cent. of the whole resistance of the lamp. The consumption, including the resistance, is 1.5 watts per candle for large lamps, and 1.6 for small lights or low pressures. In small or low-pressure lamps the loss of heat at the ends is larger in proportion.

Such a lamp as I have described will not light up of itself, for the rod is an insulator when cold. The simplest way to start it is to warm it up with a match, or better with a small spirit lamp. Such a lamp as this is not only very cheap as regards first cost, but very economical in running. The life of rods, running at an efficiency of two-thirds of a candle per watt, including the resistance, is already more than 500 hours in good specimens. If the Nernst lamp advances as much in the first few years of its existence as the carbon lamp did between 1880 and 1882, it will soon be made so well that the rods last a lifetime. When the rod is worn out, a new rod with its wire mounts is all that is replaced. The whole lamp is not thrown away at all.

The method of lighting I have described, though it may be used in many cases, such as large public rooms, is really a savage mode of ignition, fit only for dealing with uncivilized commodities, such as gas and tobacco.

The small lamps and the lamps of medium size are in practice started by a heating resistance. This is arranged close to the rod, and in shunt to it. As soon as the rod is hot enough to conduct, its current works a tiny cut-out in the resistance circuit. In large lamps the heating system is a little more elaborate, as the resistance arrangement is arranged as a sort of hood which covers the rod. As soon as the rod conducts, not only is the resistance circuit broken, but the electromagnet lifts the little hood clear off the rod. In all these forms, the rod and its mounting are replacable without interfering with the rest of the lamp.

We now have to consider the part the Nernst lamp is probably going to play in the near future.

Compared with the small incandescent lamps, as you deal with a material of much higher specific resistance, it is easy to give both small lights and high pressures. The question of lighting is exceedingly important, though it appears trifling at first sight. People are so accustomed to lamps being turned on from the door without any trouble that they will generally object to having to light them with matches or spirit lamps, but there are many cases in which it will be quite satisfactory to have one lamp with an automatic lighter to show you the way into the room, the rest being lighted with matches or a spirit lamp as needed. There will be, however, a considerable opening for the cheap, small-power, high-efficiency lamp, and the disadvantage as to lighting is small in such cases as cafes, restaurants, churches, hotels, railway stations, and, in short, in most public rooms is small.

Coming now to the next size—that is to say, lamps of 20 c. p. to 200 c. p., and even small lamps in which it is worth while to have automatic ignition—the first cost of such lamps will be higher than the first cost of incandescents, but as the rod itself has alone to be replaced, that is a matter of very slight importance. This size of Nernst lamp has, further, every chance of completely ousting the carbon incandescent on the score of cheapness, as to renewals, higher efficiency, better colored light, and, perhaps, more especially high pressures. Once the Nernst lamp becomes so general that systems of distribution are laid out to suit it, instead of to suit the carbon lamp, the carbon lamp is practically "out of the running." It must be remembered that the Nernst can compete with the carbon filament at any pressure that suits the filament, but the Nernst lamp can easily go right out of the depth of the filament and have the higher pressures to itself. It must be remembered that at present the cost of cables in a system of distribution is an exceedingly large item.

Turning now to the large lamps, they compete with the arc lamp in efficiency. Of course, the efficiency of the arc lamp is not a very definite quantity. The candle power is generally determined by multiplying the current by 2 and adding zeros at discretion. All I can say is, that however many zeros the good nature of the maker may supply, a Nernst lamp taking the same power gives a better light. When carefully arranged on the photometer, the arc may be better in given directions, but a lot of light given in directions that you do not want is not the same as the same light distributed with a uniform spherical emission. The arc lamp shown here will give the audience a good idea of the relative values. The Nernst gives a pleasanter and, of course, a perfectly steady light. Coming to costs, the Nernst will be very much cheaper in first cost, but enormously cheaper in maintenance. It also goes quite away from the arc as to pressures. There is no trouble, for instance, in making large lamps to work in parallel at 500 volts and by using double rods at 1,000 volts. This puts an entirely new development of electric lighting in the hands of the engineer.

There is one point I have said little about. The incandescent lamp which is still with us gives trouble not only because of the low pressure it needs, but also because it demands that the pressure shall be kept uniform. It seems quite possible that the Nernst lamp may be made to stand a much greater variation of pressure than the filament. If this proves true, it means an enormous difference in the designing of distribution mains. I do not like to say much about this yet, as the invention is too young, and too little time has been available to make much certain progress in that direction. Results are promising, but it is best not to be sanguine.

It is difficult to discuss an invention like this without being carried away with enthusiasm. I feel, however, that I have but feebly shown forth the probable future of what seems to me the greatest invention in electric lighting that we have seen for many years. Still, I am sure I have not been too sanguine.

Currents from Electrostatic Apparatus.[1]

BY WILLIAM JAMES MORTON, M. D.

Professor of Diseases of the Mind and Nervous System and Electro-Therapeutics in the New York Post-Graduate School and Hospital, New York City, N. Y.

IN 1881[2] I published a description of a current derivable from influence and frictional machines and capable of producing physiological tetanus in contradistinction to the single contraction so long in electro-therapeutics the familiar attribute of the spark. In 1891[3], observing that the general utility of the new method had become but little expanded in practice, I made a second extended publication, pointing out that "a regulated interruption in the otherwise inoperative circuit of a Holtz machine would produce in another part of the circuit a current adapted to electro-therapeutic practice. When Leyden Jars or other condensers were introduced within the circuit so constituted, the resultant current was termed by me the "Static Induced Current," while if condensers were not utilized I termed the current the "Franklinic Interrupted."

At this point, a word of defence may be permitted since in a late number of the "Bulletin Official de la Société Française D' Electro Théapie" (mai, 1898, p. 74) I find these words: "M. M. D'Arsonval et Bergonié reclament contre la dénomination de courants de Morton appliquée á des courants oscillatoires bien connus avant Morton. Celui-ci les appliqué le premier."

To this I would reply briefly, but I believe finally that the oscillatory nature of the single disruptive discharge or single spark was indeed "well known" (and this fact I pointed out), but that the succession or series of single sparks, producing a continued current, capable of evoking continuous muscular contraction, was not known, and was made known by my publications. The "courants oscillatoires bien connus avant Morton" would not produce a continuous muscular contraction, but only a momentary contraction. They were the oscillations characteristic of a single spark. Evidently, then, the kind of oscillatory current thus referred to is not the current which I have published and described as novel.

The older writers on frictional electricity describe the Lane electrometer and its purpose of measuring the length of spark

[1] Read before the Société Francaise d'Electrotherapie, January, 1899, by by Dr. Apostoli for the author.
[2] N. Y. Medical Record, April 2, 1881. [3] N. Y. Medical Record, Jan. 24, 1891.

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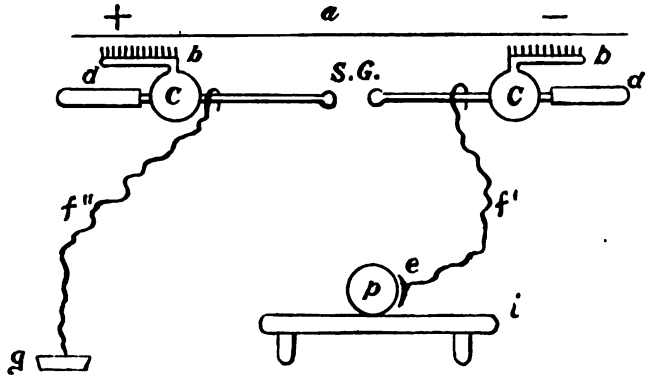
for the administration of single sparks to produce single muscular contractions, but nowhere do we find a description of a rapid series of graduated sparks employed by this or other mechanical arrangement for the purpose of the production of continuous muscular contractions or physiological tetanus, nor do we find any mention at all of the intercalation within the simple circuit without condensers, of a spark gap to produce such a current. The spark gap producing a series of sparks and its consequent peculiarity of current was the essential feature which I described as novel in my publications, as well as the application of these currents to electro-therapeutics. Such currents are now indubitably an important adjunct to electro-therapeutic administrations from influence or frictional machines, as well as to similar administrations where condensers are electrically charged by induction coils in place of such machines as in the production of the well-known high frequency, high potential currents. All such currents depend in fact upon the spark gap and spark series to give them their existence, and their special attributes, not alone in electro-therapeutics, but in the remarkable series of other phenomena pertaining to general electrical science. This spark gap and spark series combined, together with its attendant current, caused by rapidly continuous sparks, was, so far as I know, first described by me in 1881 and 1891, as referred to. The Lane electrometer, then, so far as any record goes, was never used to produce physiological tetanus, nor, indeed, the Boudet electrode, concerning which its distinguished author definitely wrote.[1].

"Dans la pratique, il est souvent necessaire de pouvoir regler l' energie et la longueur des etincelles electro statiques, surtout lorsque l' on veut localiser leur action sur un point deter-



DR. MORTON'S ARRANGEMENT OF APPARATUS.

miné du corps." Mr. Boudet made no claim to a series of sparks and a consequent current.

To make the electro-therapeutical presentation of this class of currents still more complete, I now desire to add one further phase of it which I have long practiced and found to be of invaluable service in the treatment of disease. In the case which I now refer to, the patient is not directly interposed within the sparking circuit of the machine, but he is indirectly connected by an off-shooting rheophore and electrode to that part of this circuit which constitutes one side of a spark gap whose other side is preferably connected to the ground. This disposition may be best illustrated by a diagram.

a. Rotating plate. b.b. Collecting combs. c.c. Prime conductors. dd. Discharging rods. f'. Rheophore to patient. f". Ground connection. p. Patient. e. Electrode of wet sponge or lead or other dry metallic plate in contact with the patient's body. i. Insulating platform. g. Ground connection. Upon actuating the machine and causing sparks to pass at S. G. diffusive and painless muscular contractions and other physiological effects are produced in the patient's person.

My present purpose is to describe a method. The physiological and clinical effects constitute another chapter, which I will not now touch upon further than to remark that so far as I can at present determine, by this simple means the general and constitutional effects obtained from high frequency, high potential currents by more complicated apparatus are obtainable in a remarkable degree as well as the more local effects of muscular contraction, etc., commonly sought from local electrodes.

It should also be mentioned here that currents of this description cannot be practically obtained from inadequate apparatus. The Holtz or other influence machine should have from 6 to 8 revolving plates of about 28 to 32 inches in diameter, and the machine should be run steadily and rapidly by an electric motor. These are the machines in common use in this country.

The spark passing at the spark gap may vary from the smallest one to one of three or four inches in length.

The electrodes comprise any and all that are in use. They may be wet electrodes of sponge, etc., or may be dry metallic plates. They may be preferably affixed to the patient's person, or, if held in the hands, they must be provided with insulated handles. To cite concrete cases as examples: In lumbago, sciatica, various forms of neuritis, rheumatism, neurasthenia, melancholia, etc., simple block tin plates are laid or bound upon the spot desired, and the machine actuated. In neurasthenia and general conditions a large plate is laid over and along the vertebral column. To treat conditions of the eye a small electrode of wet sponge with insulated handle may be held by the patient, etc.

Profound metabolic exchanges, as I have already determined, are effected by this current, and further prosecution of this inquiry will, I am positive, open out to our view a most interesting and valuable chapter in the electro-therapeutics of high potential currents.

[1]Electricite Medicale, etc. Par Le Dr. M. Boudet, de Paris, Paris, 1888, page 125.

TELEPHONY AND TELEGRAPHY

Various Forms of Detectors for Magnetic Space Telegraphy.[1]

BY DR. OLIVER LODGE, F. R. S.

A LARGE number of devices for improving the detector of the fluctuating current at the receiving station were made and tried, and a few of them may be here described.

Tone Telephone.—Not only was it considered desirable that the two circuits should be attuned to each other and to the sending dynamo or intermitter, but also it was thought well to make the receiving telephone so that it would only or chiefly respond to one particular note.

I had found that the diaphragm of a Bell telephone need not be free everywhere, except at the edges, but might nearly as well be fixed all over to a thin deal sound-board upon which the ear was directly pressed. Consequently I proposed to use this sound-board idea for a tone telephone.

One good form is represented in Figs. 1 and 2, where F is the tuning-fork, screwed into a sound-board, with its prongs highly magnetized, and with a short iron electromagnet between its prongs, round which the received alternating currents were to circulate. The whole was mounted in a compact case, in general appearance like a Bell telephone, and the result was very sensitive to the proper note—distinctly more so than an ordinary telephone when both were in circuit. The ear was laid right upon the wooden end, E, which holds the stem of the fork; and though, of course, the sound did not rise and decay quite sharply, yet signals could be clearly read, and the damping of the fork might at any time be increased at the expense of a little sensitiveness whenever sharper—i. e., quicker—signals were wanted. Such a tone-telephone arranged on a large sound-board, or with a resonant jar, may serve as syntonic "call," accurately discriminating one station from another.

Another use, for which it is convenient, is to serve as a weak local sender for the purpose of detecting whether the receiving circuit is properly adjusted or not. Thus, for instance, suppose signals are expected from a distant station, and are not being received, it may be because the receiving circuit, or its apparatus, has gone out of tune a little; or its tone can be tested by twitching with the fingers the tuning-fork of a tone telephone whose local circuit is properly arranged in inductive connection with the main receiving circuit. It gives at each twist a feeble alternating current which should make the receiving instruments decidedly respond. If they do not they must be adjusted till they do.

Coherer.—Another totally different form of detector was sug-

[1]Abstract of a paper read before the Institution of Electrical Engineers.

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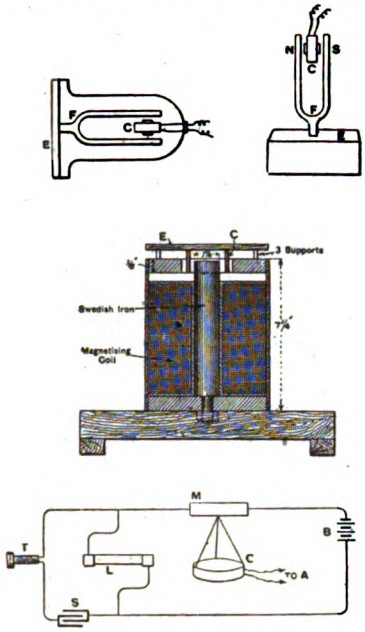
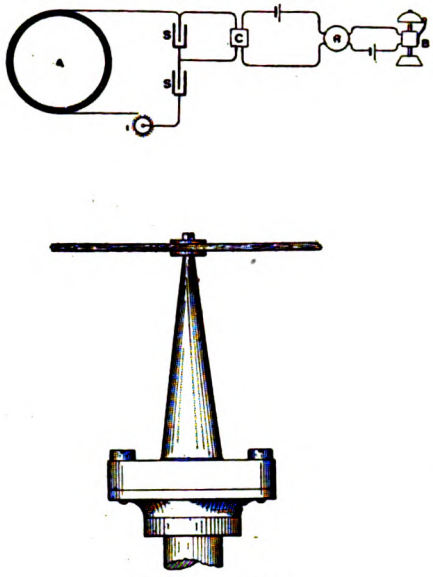
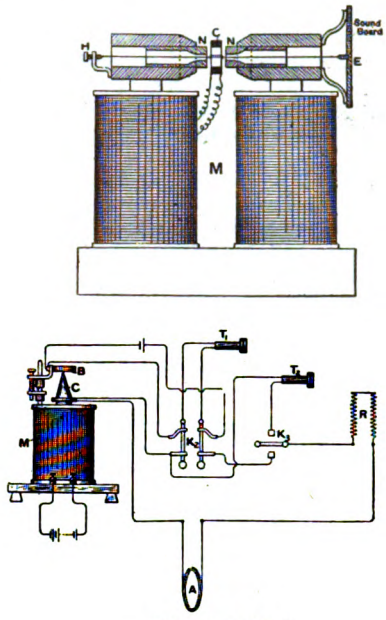
gested by the old experiment of the syntonic jars, where the air gap was filled by a pair of knobs in near contact, and with a local battery and bell—in other words, with what is called a coherer circuit. So now the receiving condenser can be shunted by a coherer, and a relay worked by the signals so obtained. But to the sinuous disturbance of an alternator a coherer turns out practically insensitive; it is to electric jerks that it responds. Accordingly, when the sender is of the make-and-break kind a coherer answers; but when it is of the slowly alternating kind it fails.



FIGS. 1, 2, 5 AND 8.

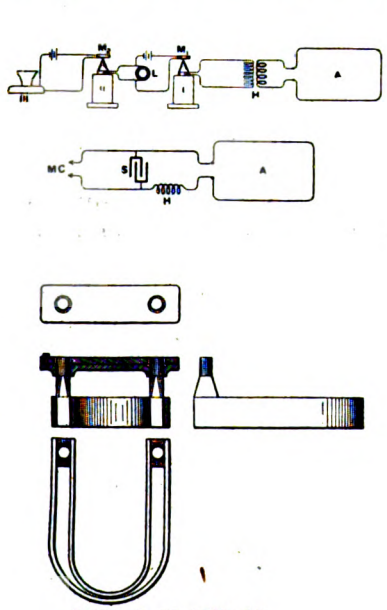

FIGS. 3 AND 6.

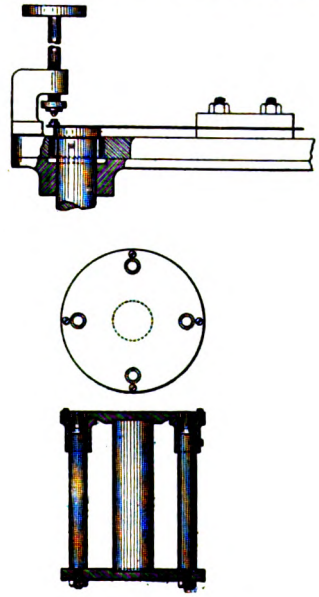


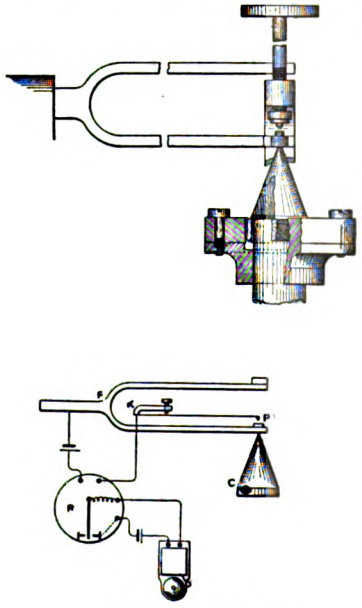
FIGS. 4 AND 7.

Coherer Call.—By inserting an interrupter in the receiving current so as to jerk any induced sinuous current that it may find there, the coherer can be made to work, and one plan of its connections is shown in Fig. 3.

It may not at first be apparent why there should be two condensers in series in this figure, but it must be remembered that the interruptor must not be allowed to affect any portion of the local battery current, or, of course, the coherer will respond when no signals are being sent.


FIGS. 9, 10 AND 13.


FIGS. 11 AND 14.


FIGS. 12 AND 15.

Bolometer.—A bolometric call was also tried, but, as it was not specially successful, the details of it will not be given.

Vibrating Coil Telephone.—For the purpose of disturbing a sound-board, and in general of producing a mechanical effect in solids or liquids, as opposed to gases, it was thought probable that an iron diaphragm was not the best plan, but that the whole receiving coil might be mounted so as to be capable of vibration in a strong magnetic field.

An early form of the vibrating coil telephone and sound-board is shown in Fig. 4, where M is a large horseshoe magnet with perforated pole-pieces, one of which carries a sound-board with stretched wire from its middle passing right through the perforations to a screw-tightener, and carrying, rigidly attached to its middle, a light fine-wire coil, matted together with shellac, and placed between the pole-pieces.

The magnet was magnetized, not in the customary way, but with its adjacent poles of the same sign, so that the lines of force spread out through the coil, and give it the chance of cutting these rapidly if it moves at all axially.

On passing full alternating currents through the coil the sound-board was strongly affected by its taut wire. A subdivided iron core was also placed in the coil, but, whether by reason of the increased mass, or for some other reason, it did not now work so well.

Another form was then made with a magnet specially designed as shown in Fig. 5.

Tambourine membranes and many other plans were tried for

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holding the coil, but the simple wooden sound-board answered best.

The present plan (Fig. 6) of a large sound-board and a light coil rigidly attached to its middle by either a light wooden tripod or light cone, was then designed, and has not been improved upon.

Magnifying Telephone.—Instead of using the vibrating coil to affect a sound-board direct, it was obvious that it might be used first to affect a microphonic contact of a local battery circuit, and thus cause a fluctuation in a stronger current than that induced from a distance, and so send on a more vigorous disturbance to another telephone, and thus cause a louder noise. For this purpose, after several microphonic transmitters had been tried, a Berliner was ultimately chosen, and arranged as in Fig. 7.

Here the ordinary telephones are arranged so that the disturbance can be heard direct without magnification and compared with the magnified disturbance. The telephone T_1 serves for both determinations according to the key which is pushed down. The telephone T_2 was a duplicate of the same make, which was inserted into either circuit when T_1 was out of it, so as to keep everything similar. It was found during the experiments that T_2 was unimportant; the resistance and inductance of the rest of the circuit were great in comparison.

At this early stage, and with the Berliner transmitter, it was found that magnification was easy when the original effect was fairly large, but that when the original effect was barely audible, magnification became difficult and never very marked.

The method of connecting the magnifier to the telephone listened to was usually as follows (see Fig. 8):

T is any telephone, diagrammatically indicated.

M is the Berliner microphonic transmitter, with receiving coil hanging on tripod from its carbon plate.

B is a battery of three storage cells; and L is a self-induction coil, without iron, which carries most of the steady current which is necessary to the good action of a microphone, but diverts the jerks and fluctuations mostly through the telephone, which might without detriment be of high resistance.

Sometimes a condenser, S, was inserted in its circuit, too, with the object of assisting through the telephone fluctuations of definite pitch.

A transformer could be used instead of the self-induction shunt, but the advantage of a transformer is more felt on long lines; for a compact apparatus it serves, too, but it wastes more power than the L shunt.

The following arrangement (Fig. 9) was tried as receiver at my house of the signals sent from College, two miles away:

A is the cable once round the garden, connected to the thick winding of a hedgehog transformer, H. Its thin winding is connected to the fine-wire suspended coil of the first magnifying telephone, I.

The currents from its transmitter, M_1, are taken to the fine-wire coil of the next magnifier, II. shunted by the low-resistance self-induction coil, L.

III. is the final telephone of the series, viz., an ordinary Western Electric loud speaker (2 ohms), in series with the transmitter M_2. Under these circumstances the signals could be heard with the ear 2 in. from the funnel of III.

But the hedgehog wasted a lot of power; its volume of iron being considerable, and the hysteresis and eddy losses at high frequency being very marked.

An improved arrangement consisted in interposing a 20-microfarad condenser (the largest then available). This was not enough to tune up the circuit, except where the thin wire circuit of the hedgehog was inclosed. So the following plan (Fig. 10) was adopted, and was a decided improvement:

M C is the magnifying arrangement, as before.

H is the thick wire of the hedgehog, inserted merely as extra self-induction.

S is a condenser having a capacity of 20 or 21, or sometimes as much as 24, microfarads (a small plug condenser being added in parallel to vary and improve the tuning).

Thus the note was enhanced by resonance, and the signals became almost loud. (The tuning at the College end happened, however, on this particular occasion to be rather poor.)

This must serve as a sample of a great number of experiments, made with all manner of condensers and different notes, an especial amount of variation being practiced at the sending end.

The Berliner, or such-like granular transmitters, though serving well to magnify an already audible current, do not serve to pick up and magnify an inaudible one. For this purpose a better and more precise apparatus has to be constructed, viz., the reed or the tuning-fork magnifying telephone, with only a single pair of carbon contacts.

This is shown in Figs. 11 and 12, and its essence is that the coil is hung to a reed or fork or vibrator of definite pitch, and carries also a pellet of carbon, which presses lightly upward on another fixed pellet, thereby constituting a single-contact microphone. Fig. 13 shows a permanent magnet, and Fig. 14 an electromagnet with spaces for the reception of coils, such as C (Fig. 15) to stand within the magnetic field.

Such an arrangement, as is well-known, is excessively sensitime to utterly imperceptible mechanical disturbances, and the minutest fluctuations of current now passing through the hanging coil give ultra-microscopic tremors sufficient to vary the resistance of the light carbon contact perceptibly; the energy of a single-cell local battery being thus brought into action, enough energy is imparted to disturb through another hanging coil one of the ordinary granular transmitters, which then passes on a stronger current to the loud speaker, or the "call." Or it may be that two reed magnifiers in series are desirable, when the received current is exceedingly faint.

The single-point magnifiers do not carry big currents, and they require delicate, though easy, adjustment; but when properly made and adjusted they work extremely well, with pure tones.

The multiple-contact microphones work better for articulate speech, as is well known. I find graphite carbon the best for these single contacts, and I am indebted to Mr. Swan, to Le Carlore, and to Mr. Acheson, for several specimens of soft carbon, which answer much better than the harder arc lamp variety.

The last telephone of the series has been so far represented as one of ordinary pattern, but it is obvious that the vibrating coil attached to a wooden sound-board may be employed; and, further, that such sound-board telephone may have an application to the human voice and the acoustics of buildings.

It is also manifest that when the vibrations are magnified they may be used to work a relay and ring a bell, or actuate a Morse instrument, or anything else, just as in the phonoporic receiver, for instance. I am indebted to Mr. Langdon Davies for the loan of one of his phonoporic receivers.

The bell-ringing arrangement that we at present prefer is a coil telephone of the tuning-fork pattern (Fig. 15), so that (if protected from mechanical shaking) it shall only respond to a definite note, and not to casual currents in the line.

Continuous working at the subject for over a year on the part of Mr. Benjamin Davies and myself, with occasional aid from instrument makers, has naturally resulted in a mass of observations and experiments. What is now published is but a fragmentary selection, but the paper is quite long enough.

Successful Trial of the Rowland Multiplex Printing Telegraph, Between Philadelphia and Jersey City.

THE Rowland multiplex printing telegraph to which reference has been made in our columns from time to time, was successfully tried last week, between Philadelphia and Jersey City, and has, we are told, proved itself a practical success in all kinds of weather.

The present apparatus, shown in Fig. 1, was made at the Johns Hopkins University and is to be regarded as an experimental one to see whether the system is worth developing further. However, it is said to be so practical that it only needs to be made in the best possible manner by a good mechanic with perfect tools, to be considered complete.

The present apparatus is arranged for eight messages, four each way, the instruments being duplexed in the ordinary manner. So far, keyboards have been completed for only six messages, but this number is sufficient to demonstrate the practicability of the system for the eight messages for which the apparatus is designed.

The messages are printed on either a tape, or better, on a page like that used on the ordinary typewriter, except that in the latter case an endless roll is used. Each page printer is under more perfect control than an ordinary typewriter as the depression of a key at any moment will send the carriage back to

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commence a new line or drop directly to a new line at any point. At present the number of characters used is 37, which includes the ordinary alphabet as well as numerals. The printing is generally clear and perfect and excels most typewriting in these respects, although some improvements are yet to be made.

The manner in which these results are accomplished is by means of a very perfect and satisfactory synchronous device operated by an alternating current, which latter is also used for the signaling. Such a synchronous device has been sought for years but the various ones discovered at various times have always been defective in some respects and readily got out of order. Professor Rowland's device has worked day after day for two years without ever giving out and is claimed to cause no trouble whatever, working day after day without any attention. This system of signaling by alternating currents is original with Professor Rowland.

It is demonstrated that this system will signal a longer distance than any other, and Professor Rowland has worked his instrument through an artificial line equivalent in resistance and capacity to 1,500 miles of land line, the total distributed capacity being 23 microfarads. This is equivalent to 60 miles of cable or more.

The messages are sent from keyboards similar to a typewriter, to which latter it can be attached and shown in Fig. 2. Each message can be sent at the rate of 40 words per minute, although, in some experiments it has been raised to 60 words per minute each one.

The highest limit possible has not yet been reached nor the limit to the number of messages.

Though the time has not arrived for a complete description of Professor Rowland's synchronizing device, it may be stated that it employs principles not foreign to apparatus of this character. An alternator at each end of the line, driven by an electric motor furnishes current for the synchronizing apparatus. These alternators have attached to their shafts a set of commutators with the required number of segments, depending upon the number of messages to be sent and the current is delivered to brushes revolving around these commutators. Each machine receives ten half waves of the current, and by cutting out half waves the local relays are operated. There is one main relay which in turn works 10 local polarized relays. The currents from these are collected by the selecting commutators, which operate the sub-local relays. There is one synchronizer for all the machines which operates a continuous current motor used for driving the entire apparatus and keeping the same in synchronism. Should it ever get out of synchronism noise in a telephone warns the operator and it can be brought back to the required state in a very brief time, and with no difficulty whatever. The advantages of the system are claimed to be as follows:

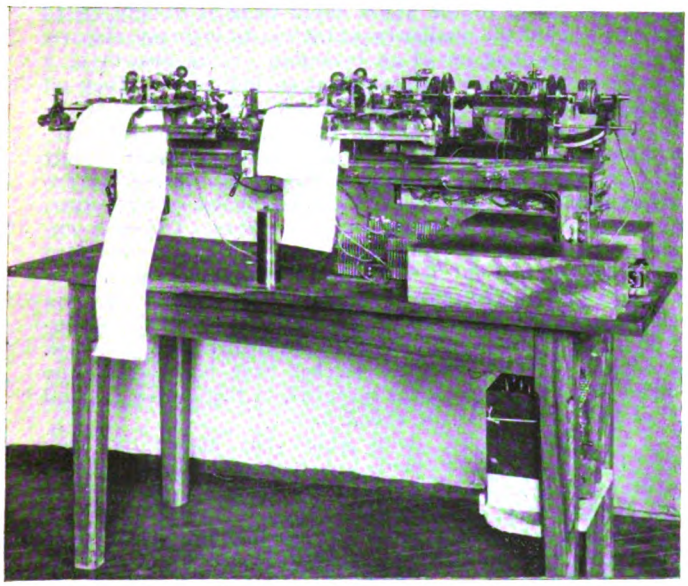

FIG. 1.—RECEIVING APPARATUS AND SYNCHRONIZER OF ROWLAND MULTIPLEX PRINTING TELEGRAPH.

1. The large increase in the capacity of telegraph lines which are thus enabled to do from two to three times the business they can now accomplish between the main points by means of the quadruplex and four times that by the duplex.

2. The saving of half the men now employed as only a sender is needed, whereas both a sender and a receiver are needd on the Morse system. Any typewriter can learn to print slowly on the Rowland system in a few minutes and 35 or 40 words per minute in a week or a month, according to brightness.

3. It is well known that the Morse system soon develops a disease in the telegraphers known as "losing their grip" which is similar to writers' cramp. This diminishes their speed and often disables them entirely so that it is often stated that the life of a telegrapher when he can do his best work is limited to ten years and a man of fifty who retains his "grip" is a great rarity. The keyboard never develops this disease, and, indeed, is often a cure for it.

4. The system is more accurate than the Morse as, in each message, there is only one person to make an error, whereas in the Morse system there are two.

FIG. 2.—KEYBOARD USED FOR SENDING IN ROWLAND MULTIPLEX PRINTING TELEGRAPH.

In case of any words about which there is doubt a bell or other means warns the sender to repeat the message.

5. The system works better in bad weather than the quadruplex which is out of order often half the time. Furthermore, it works at a greater distance than any known system, the distance from Chicago to New York without relaying being much within its limit.

6. There is no other multiplex printing system sending from a keyboard and receiving on a page in existence to-day. There is also no simple page printer having such speed and such perfect control over page and line as is here secured.

7. Such perfect synchronism which never fails has never before been obtained. It may be mentioned that in case a break in the line or other cause, throws the machines out of synchronism, they may be put in again and ready for work often in 30 seconds and seldom requiring one minute. Also nobody can tap a wire and get stolen news by this system.

The present system is only a part of that invented by Professor Rowland. The whole system includes a method of relaying by which the whole country can be covered without trouble. It includes a system by which 8 brokers in one city can each be in communication with one of 8 brokers in another city over one wire between the cities in such a manner that the communication is perfectly secret. He has also a quadruplex system working with an alternating dynamo at one end only.

NATIONAL GREATNESS. That neither patriotism nor good sense is yet extinct among Spanish writers on public affairs is clearly proved by the article on "True National Greatness" which "The Living Age" published in its number for March 4. It is written by E. Gomez de Baquero, and is translated from "La Espana Moderna." It is a very sane and candid article, and shows a clear perception of the needs of Spain.

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An Announcement.

ON and after March 11 "The Electrical Engineer" and "The Electrical World" will be issued weekly as one publication, to be known as "Electrical World and Electrical Engineer," under the editorship of Mr. T. Commerford Martin and Mr. W. D. Weaver, and the business management of Mr. James M. Wakeman, until recently of the "American Machinist," and Mr. A. C. Shaw.

The combined journal will be conducted along broad and well-determined lines as a high class representative of the American electrical industry and of the electrical engineering profession. The best features of the original journals will be retained, and others introduced with the definite object of publishing an electrical periodical without rival in its special field.

By thus combining to the obvious advantage of the reader and the advertiser, the effort heretofore divided between the two leading weekly electrical publications, a technical and industrial journal will be produced that should worthily represent the important field covered, and rank among the great engineering and industrial periodicals of the world.

A Farewell.

LONG actively interested in matters pertaining to technical education the writer and his associates believed that in the founding of The Electrical Engineer Institute of Correspondence Instruction there lay the means of disseminating a systematic knowledge of electricity which no other system of popular instruction could hope to accomplish. In that view they were not mistaken, and but a few months of active operation served to more than bear out the early assumptions. With the constantly increasing number of students and special courses called for by them came increased responsibilities and demands upon time which could be but ill spared from the writer's duties on this journal. It has now become abundantly evident that to meet the obligations which the Institute has imposed upon itself will require the undivided attention of the writer, and he seizes the present opportunity of announcing his withdrawal from the editorial staff of The Electrical Engineer, in order to devote himself entirely to the work of The Electrical Engineer Institute.

In making this announcement the writer need hardly express the regrets he feels at this partial severance of the more than cordial connection of many years' standing; nor can he lightly pass over the mention of the universal courtesies and confidences which have been bestowed upon him in the past—all of which have made business a pleasure indeed, and without which he is free to say his work could not have been performed.

While thus bidding farewell as an editor of The Electrical Engineer, the writer brings to the work of The Electrical Engineer Institute the encouragement accorded him in the past. It affords him particular pleasure to announce, also, that Mr. T. C. Martin will continue to act as vice-president of the Institute, and to aid it with his ripe experience. JOSEPH WETZLER.

Menlo Park.

IT would not be proper to allow the death of Mr. John Kruesi to pass without at least a brief tribute from our pen. His career as one of Mr. Edison's faithful and loyal associates is set forth elsewhere in this issue, and was that of an extremely able but modest engineer, who to the last manifested the fine mechanical instincts and aptitudes that have made the Swiss leaders in the production of beautiful apparatus. That he was one of the little band which toiled and moiled ceaselessly at Menlo Park in the early days when new arts sprang into being there every morning, was one of the things that made him proud. Those of us who shared the distinction with him, no matter in how small a degree, have something that makes us proud also; for the passing years only add to the splendor of the achievements of that time. None but the men who went through the ordeal can ever tell how strenuous was that struggle to wrest from Nature her secrets and convert them into blessings for mankind.

"Honest John," as we all fondly called him, is the first of the members of the old Menlo Park staff to pass away. His comrades, as they lay wreaths of affection and esteem on his bier, trust that the record of each may be as pure as his, as full of deeds of kindness, and not less marked by humble devotion to duty. His career was a noble example for all who would make honorable places for themselves in the profession of electrical engineering.

Uses and Influence of the Automobile.

IN the discussion of the above topic there is vividly called to one's mind the similarity which exists in many respects between the development of an invention or the growth of a new industry and the life or career of an individual. They all follow the same fundamental law, namely, the survival of the fittest, and are subject to similar uncontrollable and unforeseen circumstances and conditions. We watch them closely from their birth, bestow infinite care upon them during the experimental stages of the one and the childhood of the other, readily overlooking any shortcomings or errors. The early experiments, as well as training of the individual, are conducted with no definite aim in view until the time arrives when certain results and characteristics manifest themselves, whereupon developments most conducive to the future value of the invention or industry and welfare of the individual naturally follow. And finally, after the finishing touches have been added, the questions are put: "What is the invention or the apparatus good for?" or "Of what use is the young man?"

It is this "psychologic" point which has apparently been reached by the growing automobile industry, if one is to judge from the numerous questions as to the uses and influences of the automobile asked by the public.

Leaving time to solve all questions relating to the construction of automobiles as well as their cost, performance and motive power, which have frequently been discussed in our columns and elsewhere, we find a complete, epigrammatic reply to the many queries in a statement by Mr. A. L. Riker in a recent lecture entitled: "The Horseless City, or the Age of the Automobile," where he says that "in substituting the automobile for the horse, we save space, time and money."

That we save space needs no argument, as the length of an automobile is only about one-half that of a horse vehicle, so that we can put twice the number of the former in the space occupied by the latter. Besides saving space, it will also be

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less destructive to pavements, and will be a greater factor than the bicycle has been in bringing about the asphalting of our city streets. This, besides being a much pleasanter pavement to ride upon, is easier to clean, and reduces noise and repairs to a minimum.

In the horseless city, according to Mr. Riker, we will build our houses so that we can have a space in them for an automobile. This is already being done, he states. The readiness of an electric carriage is especially pleasant on a stormy evening, as one can enter it under cover and not run the risk of getting wet.

Another feature of the automobile is its disregard for the weather. If the thermometer is 100 degrees in the shade, or 20 degrees below zero, we do not have to worry. Recent events have amply demonstrated this fact, automobiles being the only carriages obtainable one night. It may be of interest to state here, in support of the adaptability of automobiles for commercial delivery service that in the last storm an electric delivery wagon actually pulled a horse vehicle out of a drift in which it had been stalled in New York City.

Aside from the fact that it is most cruel to take a horse out in all sorts of weather, often requiring from that animal severe exertion as to speed, the automobile is an ideal vehicle for a physician, always ready, whether in storm or sunshine, to go at a moment's notice at a gait impossible with a horse, and to wait in a bitter storm without injury. No less commendable for similar reasons are the self-propelled fire engines, several of which are already in use in this country and abroad. For ambulance service, it is unsurpassed, and in London electrically propelled mail wagons have, it is alleged, won considerable favor. The use of automobiles for the hauling of heavy loads has received an enormous impetus abroad, where one city has gone as far as to pass an ordinance that no vehicle over a certain weight can use the horse as a motor, but must have some other power to move it.

Finally, the use of automobiles has been proposed for the conveyance of invalids, for which purpose it appears to be admirably adapted in its more diminutive and lighter forms. The latest suggestion, however, comes from abroad, where the electrically propelled vehicle is recommended for use by the army in the field on account of its absence of heat and odor when compared with vehicles propelled by steam, gas, petroleum or benzine. Its highly commendable properties, however, are the absence of smoke and noise, and the ability to attain high speeds. It has also been proposed to construct these vehicles in such a manner that they might be used as land torpedoes, serving as a means of attack while made safe for its occupants by covering it with a bullet-proof armor. Thus we see that, besides serving as a pleasure vehicle or for purely commercial purposes, automobiles may be employed as a means of defence, as an important factor in improving the sanitary conditions and pavements of cities, as well as in building operations. It will have its effects, as has already been pointed out in these columns, on the carriage building, storage battery, motor and other industries, and a possible influence on human character in promoting sobriety and honesty.

Municipal Telephony.

ONE of the important electrical questions which came up recently in England was that connected with the proposed development of municipal telephony. The success assumed to have been made by municipal plants for lighting and street railway work has led those who want public officials to conduct all public service plants to advocate the establishment of municipal telephone exchanges. Of course, the assumptions as to municipal success in other lines are well known to rest on rather thin air, but that makes no difference to the agitators now busy with the question in England.

The matter has lately been taken up in America, and from various parts of the country we hear reports of proposed municipal telephone exchanges. Duluth appears to have the craze badly, and the Mayor has been advocating the proposition. But it should be enough to kill the scheme simply to point out that the exchange could have no toll lines and no long-distance connections. Its service would necessarily be purely and solely local, and any telephone system which is only that to-day stands confessed a failure.

Rather curiously that limitation has come up in England in regard to power transmission from the coal fields to the cities. The "municipalities" are opposing the recent plans developed under private enterprise, asserting that such work should be in the hands of the localities affected or of the State. But how localities are to engage in work extending over several districts and counties is inconceivable, and it is equally difficult to imagine how the State could own the coal mines and the lines and make "deals" and "dickers" with the various municipalities along the route. Surely this is an operation to be left in the hands of private corporations and to be governed by the principles of trade and industry and competition.

The Electrolytic Interrupter.

EVER and anon the world's stock of knowledge or the tools of science are enriched by some discovery or invention distinguished for its simplicity, and simplicity indeed is the mark of greatness in both. Judged by this standard, the Wehnelt electrolytic interrupter is unquestionably entitled to be classed among the great inventions of the past few years. With that keen insight into the nature of electrical phenomena for which he is noted, Prof. Elihu Thomson has taken up this apparatus, and the results he has obtained in the limited time thus far at his disposal prove that we were not mistaken in our original estimate of this remarkable device. But the restless ingenuity of Prof. Thomson did not stop at the mere repetition of Dr. Wehnelt's work. On the contrary, he has already developed the original idea in various directions with most gratifying results. He also foreshadows further results in the near future which will without doubt be awaited with much interest. We should not be astonished to find the electrolytic interrupter put to uses now scarcely thought of. It may indeed make practical many ideas that have heretofore been languishing from the want of just such a simple device. On the other hand, we may look for a decided increase in many present applications of electricity. We need go not farther than X-ray work to demonstrate what will be the result of the introduction of a device which is simple, without any moving parts, which permits of smaller coils, and which can be obtained at a trifling cost, while the effects obtained are unrivaled for steadiness and power. We may also hope to hear of its use in wireless telegraphy, while we are not at all so sure what the electrolytic interrupter may not be heard from in connection with heavier electrical engineering work.

Theory of Coherers.

Some experiments are described which should decide between the coherer theories put forward by Lodge and Branly respectively. The action of electric waves upon a gap between the spherical ends of two thin platinum wires, as observed under the microscope, drew the ends together when their distance apart was reduced to 0.004 mm. They remained sticking together after the radiation had ceased. In another experiment two mercury drops, separated by a thin, surface contamination of chalk, coalesced under the influence of electric radiation. These experiments proved that actual metallic contact is created, and controvert Branly's hypothesis of a modification of the intervening dielectric.—D. van Gulik, Wied Annalen.

Do We Age More Quickly?

Do we age more slowly than our forefathers did? is a question asked by Dr. W. Ainslie Hollis, physician at the Sussex County Hospital, in the London "Lancet," and answered by himself in the affirmative. He quotes statistics in support of his argument, and refers to many cases of famous veterans in Europe who continue to uphold their early reputations for longevity, which, he says, is one of the most striking features of the present age. Undoubtedly the improved sanitary conditions in modern times and the gradual education of the people in the science of living and the more mature age at which people marry nowadays extend the period of adolescence. Apropos of the above, Dr. Julius Althaus discusses the question how to prevent old age, and says the only way is to be careful to appropriate and use the galvanic current, which he has studied and experimented upon over forty years, and lays the charge against doctors of having far too long neglected electricity in cases of debility and exhaustion, in which he himself has often obtained results. He has known men prematurely aged after treatment look ten years younger, be restored in temper, take fresh interest in life and have quicker digestion and healthier sleep.

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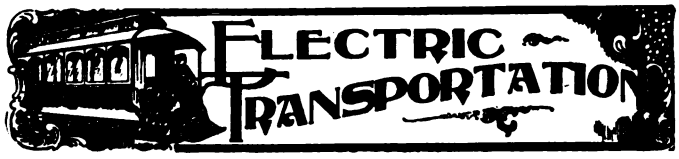

The Motor Vehicle in Commercial Operation.[1]

BY G. HERBERT CONDICT.

WE are told that about 2,500 years ago there lived a prophet, Ezekiel, who had a vision, and in this vision he saw some marvelous wheels. Without attempting to determine what was meant by the vision, let us appropriate his statement regarding those wheels, as a text for this talk on the horseless vehicle. "For the spirit of the living creature was in the wheels." What an apt and concise description of the vehicle which, having discarded the "living creature," "the horse," still moves on with his "spirit."

We are but just entering a new era in the art of transportation. As the advent of the electric car brought a revolution in local rail transportation, so the advent of the road vehicle which goes without horses, has commenced its triumphant campaign. Having come out victorious on the rail, the horseless forces are now gathering for the battle on the road. Even the Tammany brave is putting on his war paint and is thirsting for the fray. The "trolley buggy" is "the thing," and the "hay-motor" "sees his finish."

As we all know, the use of the horseless vehicle abroad far surpasses the little that has been accomplished in this country, but oil and steam furnish the power almost exclusively, and the electrics are in the meagre minority. With oil, gas and steam motors counted by the thousands, the electric foots up only by tens.

Far different is the case on this side of the ocean. Oil, gas and steam vehicles are few in number, and there are not 150 electrics in actual service. Yet there is no room for despair, for the Yankee rig, especially the electric, has already made an enviable reputation for itself, and promises to distance all comers.

Only two or three remarks can be made here regarding the relative merits of the various forms of power used to make the wheels go round.

Undoubtedly there will be discovered a place for each system in which peculiar adaptation to local conditions will render competition in that particular field, by less favored rivals, improbable.

I am not referring here to the light pleasure vehicles engineered by the owner, who, as a general proposition, cares comparatively little what the cost of operation amounts to, but to that business affair that is to carry you and your goods to and fro in all conditions of weather—rain, shine, snow and sleet—within the narrow confines of the city streets. It was the raging blizzards of the present season that served more than anything else to bring into prominence the motor vehicle, which ventured in where horses feared to tread, and, in spite of all prophecies to the contrary, got out again with ease. It is in such service that the future of the automobile is to be filled with glory.

City transportation must be carried on with as little interference with the rights and comforts of others as possible. No motor depending in any degree on any of the products of petroleum is free from disagreeable odor. The principal streets of Paris, where the oil motor holds sway, are filled with the offensive odor so inseparable from the oil well districts of Pennsylvania. A trail of unsightly vapor accompanies the onward march of the steam motor, particularly in cold weather. Vibration produced by the reciprocating parts of many motors is very disagreeable, especially when they are operated slowly and stopped and started frequently, as in municipal service. But the electric, noiseless, odorless, vaporless, operating without jar or vibration, surely it has found a field in which its virtues can shine without fear of the dimming shadow of a close rival!

In the crowded narrow streets of the city it excels in all that goes to make up a mode of transportation void of offense, but some one says that the electric is a great, heavy, cumbersome thing. Yes, it is. That is the fault of our storage battery friends. The battery is the "champion heavy weight" of the electrical fraternity. It is a case of full weight for the money, when you buy one. But no one buys a motor vehicle by the pound, and it does not make any particular difference what the weight is if the thing performs successfully and economically the work for which it was fashioned. In this connection it is often necessary to remind the critic that in comparing the horse vehicles and the motor vehicles the weight of the horse or horses must be included in the weight of the former. Of course, we all know that the moving of weight calls for more expenditure of energy, and unless this expenditure is offset in some other direction, the system having the burden must fail. If the heavy vehicle can transport a passenger or a ton of pay load from one point to another in a more acceptable manner than a light vehicle the former does the business. At this time it is impossible to obtain reliable data for the comparison of cost of operation of the various systems now on the market. Figures made up from absurdly inadequate data have been published from time to time, but so far nothing of much value is known on this point. By "cost of operation" I mean the total expenditure in cash for fuel, oil, attendance, repairs and replacements of parts for a period of sufficient length to secure a fair average. Such observation should extend over, at the very least, a year, and there has been no commercial operation of any magnitude in this country, or any other for any length of time. In Europe, in spite of the fact that thousands of automobiles are used for pleasure riding, there is to-day only one cab station in actual operation and a few light delivery wagons with here and there a lumbering steam truck, or a fear-inspiring omnibus. In this country a few cabs are operated from one little station, and, perhaps, a dozen delivery wagons. In spite of the most unqualified success of these few vehicles, we know them to be far from perfect, and more than that we know how to make many most important improvements.

The most unexpected demand during the last few weeks for the electric cab in this city has given it a test which years of ordinary intermittent operation could not furnish. Its faults have glared out prominently, its virtues have shown in a brilliant manner, and as one of our daily "contemporaries" says: "In all its picturesque ugliness, the automobile is a boon and a blessing. * * * We not only give it our respect, but our admiration. * * * The gentle horse has had his day." Having covered over 250,000 miles of actual and commercial service, the vehicle has proved itself no longer a toy to be played with by the wealthy but a practical thing, which is to come to the aid of the dwellers in our great cities who are anxiously beholding the vast congestion of traffic in the streets and wondering what is to become of it in the future. The modern Rip Van Winkle goes to sleep for much less than twenty years, and when he awakes, what does he behold? The streets of the city are clean (!), no rails cut up the smooth surface, no horse or any other beast is here, they are prohibited within the city limits. The pedestrian wends his quiet way along the sidewalks elevated to the second story and bridges over the street, while below the agile electric darts at good speed back and forth on its noiseless, easy-riding pneumatic tires, carrying all manner of humanity and its goods and chattels, and delivering them, not at the curbstone, but at the doorstep. The "living creature" has departed, but his "spirit is in the wheels." The elevated train, the cable and the trolley car have disappeared, but far below the surface glides the electric local and express in light and well-ventilated subways. The streets made wider by the absence of sidewalks on the same level allow a free movement of vehicular traffic, and the second story stores are free from the dirt and turmoil now so overpowering.

And now, for a moment, let us consider this electric vehicle station, the first in the world in which the batteries are transferred by mechanical means entirely, the whole operation being under the control of one man standing on the platform of the electric crane.

The men who organized the company looked at the crude and inefficient apparatus which was at their disposal, and saw in it the possibilities of a great industry. They decided to put sufficient capital at work to develop their ideas, and the present success of electric cabs bears abundant testimony to the wisdom of their decision. This station was equipped with the most approved battery handling apparatus then obtainable, and no expense was saved in procuring the very latest improvements in all of the various parts which go to make up a vehicle which could be depended on to do the work required of it. The supply is so absurdly inadequate to fill the demand that operation is carried forward under great disadvantages, considering the many component parts that are altogether incomplete

[1] Meeting of N. Y. Elec. Society, Feb. 14, 1899.

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and experimental. It has been impossible to make accurate tests of the efficiencies of motors, batteries, gearing, bearings, etc., although such data is now being obtained. There is still much to be desired, and in future equipments most material improvements will be made.

Outside of the consideration of large weight in proportion to power delivered, the battery has been giving excellent service. Up to the present time there has been practically no expense for maintenance, and the old-time troubles of buckling short circuiting, sulphating, disintegrating, are as yet entirely absent.

The tire situation is at present the absorbing subject of our day thoughts and night dreams. Were the streets in this great metropolis paved in an up-to-date manner, there would be comparatively little cause for anxiety on this score, but with the antiquated and despicable cobble, the case is far different. Over twenty separate and distinct types of tires have been tried, or are to be tried in the near future, and others will probably follow. Solid, single and double tube pneumatic, cushion, clincher, sectional, protected and unprotected have all had or are to have a trial. Their faults are many, their virtues few, and we are still on the search. We have heard of some eminent authorities in the motor vehicle field, who say that the solid is the only tire. They are rendering judgment without full knowledge of the facts, and from a purely local standpoint. They are evidently not acquainted with the streets of Manhattan. A very satisfactory arrangement for broughams is that of rear pneumatics and front solids.

The wheels also require most serious consideration. The severe strains unavoidable in crossing railroad tracks and other inequalities and running up against curbstones speedily put out of service even the most substantial constructions. Everything from the light and airy bicycle wheel construction to the dish-pan wheels, now so familiar on our streets, have been tried, and still there are more to follow. I mention these few items simply to indicate some of the most important and particular directions in which the work is progressing.

I have been asked by our worthy secretary to say something about the "auto-truck," that mysterious being fed on wind, and on the breath of "bulls and bears" and "lambs." The daily papers have been full of him lately, and why should I weary you with a repetition of how the poor truckman is to be benefited by the advent of this new beast, or how the world in general is to receive a blessing when he breathes. "This is the age of miracles," and "all things come to him who waits." We have been waiting a long time, and now possibly even compressed air will come to us on wheels.

Motor Installation at the Chicago Daily News Office.[1]

BY CHARLES A. DRESSER.

IN the great development which has occurred in the application of electric power to various forms of machinery, the operation of large newspaper presses by electric motors had become during the year of 1898, one of the most important problems to be solved, and several plants were installed in this country which accomplished their purpose to some extent, but which nevertheless presented as many or more obstacles to the pressman in getting his press ready than the old mechanical method of operation. It must be remembered that taking, for instance, the modern Hoe quadruple press, the first thing to be accomplished in getting the press ready is the putting on of the plates, and in order to do this a man was stationed at one side of the press where he could operate, by means of foot pressure, a friction clutch; another man was stationed at the point where the plates were to be placed on the cylinders, and would give the first man a signal; the first operator would then apply the power to get the cylinders in the proper place. Assuming that the plates were successfully placed on the press, the next operation is the feeding of the paper through the press.

[1]Read before the Chicago Electrical Association.

The roll of paper used on such a press weighs approximately 2,000 lbs., and ordinarily this is placed on a spindle at one end of the press, and two operators take hold of the thin sheet and cautiously thread it through the various intricate rollers and folders, etc., necessary to produce a complete newspaper. This operation is a very tedious one, and as can be readily seen any unsteady or jerking motion exerted in a thin sheet of paper pulling a roll weighing 2,000 lbs. would necessarily break the paper and require a repetition of the threading process. The total length of paper in the press is about sixty feet. The two operators guide the paper with their hands up to the various rolls, and from the rolls, after it has passed through them, until the press is completely threaded. To do this an absolutely steady motion is not only necessary to avoid the breaking of the paper, but as the operators become familiar with the speed at which the paper is winding through, and are constantly pulling on the sheet, with a certain amount of tension it will be seen that, if there should be a sudden acceleration of the speed of the motor, their hands are likely to be caught in the rolls, and many serious accidents have occurred from this cause.

In the newspaper plants equipped electrically previous to the installation of the Chicago "Daily News" plant, a single motor was used, either geared or directly connected to the main shaft of the press. This motor was controlled by an ordinary speed controller operated by hand, and which presented many of the difficulties of the old friction clutch mechanical method, inasmuch as it required two operators, one to control the movement of the press and the other to put on the plates. It is a well-known fact that when a piece of machinery to be driven by a motor is started from a dead standstill, the motor momentarily takes a vastly greater amount of current to start it than after it has acquired its motion. To overcome this the old system of electric hand control necessitated the operator's throwing the rheostat arm around a considerable distance in order to cut out enough resistance to give the motor sufficient current to start, and after the motor had started he must then move the rheostat arm back toward the starting point in order to get the slow motion. In this old method of control it is absolutely impossible to avoid a certain jump or start of the motor, consequently the fixing the position of the cylinders for the putting on of the plates is a matter of much greater time consumption on the part of the operator than with the auxiliary motor described hereafter, while the threading of the paper also takes more care and trouble. Therefore, while this system has been successfully used in small newspaper plants where the consideration of first cost is greater than rapidity and labor-saving devices to gain every possible minute in getting out the edition on time, it has been demonstrated far behind the requirements of a modern large newspaper printing office.

At the "Daily News" each press is equipped with two electric motors, the first motor being a 5 h. p. six-pole motor, having a maximum speed of 200 revolutions, and suspended on the press at right angles to the main driving shaft. On the shaft of this motor is an automatic friction clutch and worm, which engages with a brass gear wheel situated on the main shaft of the press. The maximum speed of the press at the maximum speed of this 5 h. p. motor is ten revolutions per minute. It will be readily seen that by the use of a worm a direct thrust is avoided, and an even, steady motion is given to the gear, making it impossible to have any jumps or jerks. Each 5 h. p. motor is operated from a speed regulator which has mounted on its face one compressed air cylinder and one dash pot cylinder and a contact lever, which is connected to both cylinders. At four different points on the press are located four-way compressed air cocks which are in turn connected by piping to the cylinders on the rheostat. These compressed air cocks are normally in a vertical position.

In starting the press the operator moves the compressed air cock to the left, which admits air into one end of the cylinder and opens the other side; the air rushing in one end of the cylinder forces a plunger through the length of the cylinder, this plunger, being connected to the contact arm, forces it over, cutting out the different steps of resistance. The dash pot, being connected likewise to the contact arm, retards the movement so as to cut out the resistance gradually. A valve in this dash pot regulates the speed with which this resistance is cut out, and can be adjusted to give any desired rapidity of cutting out resistance. In shutting off this motor the operator moves the four-way cock to the right, thereby reversing the pressure and also reversing the direction of the contact arm.

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By the manipulation of this air cock it will readily be seen that the operator can move the cylinders on the press any desired distance, even down to a sixteenth of an inch and the greatest dexterity in the handling of this plant is acquired in a few hours' practice by the operator. Furthermore, if the contact arm on the rheostat is on any desired speed point, by quickly placing the air cock in the neutral position, the pressure on both sides is balanced and the contact arm remains stationary.

The main power for each press is derived from a 40 h. p. slow-speed multipolar motor geared to the press by a single reduction gear and located under the press in the basement of the press-room. This motor is set on two sliding rails placed on brick piers, a single reduction gear being used so that the motor can be quickly disengaged from the gear and any necessary repairs made, it being essential in the operation of a newspaper to have quick action in case of accident. Each motor is controlled by a 40 h. p. speed regulating rheostat having 55 contact points. On each press are situated nine push button stations conveniently located, consisting of two compressed air valves and one electric push button.

The rheostat arm for the large motor revolves in a circle over the rheostat points on a shaft which extends through the rheostat to the rear where a pinion is placed on the end of the shaft, engaging with a rack which moves in a vertical direction up or down, according to the direction desired for the rheostat arm. On the end of this rack is a plunger which fits into a cylinder. This cylinder is between two other cylinders of equal size, connected with the air supply in such a manner as to leave the pressure always equally balanced unless an exhaust is introduced. In these three cylinders is as much water as the capacity of two cylinders. Floating on this water in each of the outside cylinders is a rubber ball which acts as a check valve as hereinafter described.

Now, assuming that the rheostat arm is on the first contact point, and we wish to start the motor, we press the "on" button and exhaust the air from the right-hand cylinder. The pressure being on the end of the opposite cylinder forces the water downward through the left-hand cylinder through the central cylinder, and up into the right-hand cylinder until the rubber ball in the left-hand cylinder is forced by the pressure behind it into a valve seat at the bottom of the cylinder, thus preventing any further pressure on the piston. The ball in the right-hand cylinder, on the other hand, is forced upward into a valve seat, preventing the water from getting into the air pipes. In this operation the water from the left-hand cylinder presses the plunger in the central cylinder down, and the rack engaging with the pinion of the rheostat shaft moves the rheostat arm around, while on the other side of the plunger the water is forced before it into the right-hand cylinder. When all the water has been forced from one extreme position to the other extreme, the rheostat arm has traveled the entire circle, and is on the last point, and all the resistance is cut out. By the operator removing his finger from the push button the air pressure in both outside cylinders is the same, and therefore maintains the rheostat arm in any position desired. This ability to maintain a constant speed on any point for the large motor during its operation of the press is one of the most important features in the handling of a large newspaper press. With the old mechanical drive the maximum speed is the only speed possible after the press has obtained its momentum. If it is desired to slow down the same operation is accomplished by pressing the "off" button, which reverses the flow of pressure and water, and accomplishes the desired result. On the face of each large rheostat is a main line switch on a pivot. The terminals of this switch are so arranged that a straight line drawn from each contact point to its opposite, i. e., two straight lines drawn from the contact points would form an X. When the switch is closed the left side is up and the right side down. Attached to this switch on each side of the pivot are two springs, one operating up, the other down, which tend to pull the switch open. The switch is normally held in position by a dog, which is the armature of the magnet. This magnet is in series with the field, but the current is short circuited around each through a mercury cup. On this cup is a solenoid, which is energized by a motor generator. This motor generator is in series with the electric push button at each push button station, and when the circuit is broken by pressing one of these buttons, this solenoid is cut out, and the contact is broken by means of a spring, and the current is diverted through the magnet on the rheostat. This magnet attracts the armature, releases the main switch, which is pulled to the opposite position by the springs already described. In breaking the circuit and arriving at the stops the switch opens a compressed air valve similar to the "off" button, which forces the rheostat arm around to the starting position. When the rheostat arm reaches the starting position it opens a second compressed air valve, which operates a little auxiliary cylinder similar to the one on the small rheostat, which forces up a piston rod and locks the main line switch, the piston returning to its normal position, by means of springs attached to a piston which draw it back, leaving the resistance all in and the motor ready to be started again by pushing the "on" button.

On each press just at the point where the paper is fed into the press are two tension rolls which have a lateral motion of about two inches on an inclined plane. The paper normally, by its own strength, holds these tension rolls at the upper end of this incline. On the right-hand supporting bracket of each tension roll, and at the lower end of this incline is located an electric button similar to the emergency stop at the push button stations. If, by any accident, this paper is broken the tension roll is released, rolls down this incline, touches the emergency stop and immediately shuts down the press. This simple little device makes it absolutely impossible for the paper to become jammed and clogged in the press, and saves much trouble and annoyance, and absolutely does away with any supervision or delay ordinarily necessary when a press is shut down by hand power.

In the basement are four enormous reels, each capable of holding four rolls of paper weighing 2,000 lbs., each designed so that it is not necessary to shut down the press every time the roll is changed as by the old method. On each of these reels is geared a 2 h. p. reversible series wound motor governed by a brake, and in circuit with a double-pole double-throw switch. No rheostat is used with these motors, but when a roll is exhausted, and it is necessary to turn the reel to bring another roll of paper into use, this switch is thrown, and the roll brought to its proper position. Now, assuming that one roll is being rolled off through the press, the end of the second roll of paper is brought up through the floor and attached by little tacks. When the first roll is finished a boy puts paste on the end of this new roll, and has it ready for action. When the time arrives for changing from one roll to another the "off" button is pushed, the motor slowed down, until the press is at about one-twentieth of its maximum speed, then the boy takes the end of the paper, quickly slaps it on to the old roll, the paper is carried on as if it were one continuous roll, and in the space of less than half a minute, the press is again operating at full speed, and turning out sixteen-page papers at the rate of 24,000 per hour.

Now, assuming that there is no paper in the press, and that there are no plates on the cylinders, the first operation is the putting on of the plates, which are brought in through the basement and shot up on a small elevator to the press floor. The operator has his hand on the compressed air cock of the small motor, he shouts "look out," gives the compressed air cock a slight turn, and his cylinder is in position to receive the first plates. These are put on and firmly bolted. He is then ready to give the cylinder a half turn to receive the opposite plates. He again works the compressed air cock until he brings the cylinder into the proper position, this operation being repeated as many times as is necessary until all the cylinders on the press have received their equipment of 32 plates.

The next step is to thread the paper. Two men take the end of the thin sheet, pass it around the first two rollers, then over the tension roll, and from there into the various intricate twists and turns in the press, which is now revolving at full speed when operated by the small motor, viz., 10 r. p. m. The paper is gradually taken through until we see the folded papers coming out at the finishing end. The pressman examines the paper to see that it is properly printed, and that the pages are in regular order. This being demonstrated, he is ready to run off his paper. Again he cries "look out," the press and motor being already in operation, the small motor doing the work and the large motor being mechanically driven by its engaging gear on the press shaft, there is therefore no inertia to be overcome, there is no starting a large piece of machinery from a dead standstill, and the consequent influx of current. We press the "on" button, the large rheostat arm begins to revolve, and when it arrives at the point of starting of the point, the automatic friction clutch on the small motor shaft is disengaged, the small motor has then finished its work, and is stopped, and the big machine begins to hum. By the operator's keeping his hand

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on the "on" button he can attain any desired speed for the press up to the maximum. From this time forth everything is noise and racket, and papers are piling out and being carried away by the automatic carriers, and within a very few minutes are distributed on the streets by the newsboys.

Too much credit cannot be given to Mr. Irving Stone, mechanical engineer of the "Daily News and Record," who, by his progressive ideas and great ingenuity and his untiring efforts to assist the contractors with his practical ideas, made this plant possible. Mr. Stone has many other original devices in his pressroom, among which his automatic compressed air governor, which regulates the tension of the paper, and his automatic paper carriers might be mentioned.

In general, Mr. Stone states that this apparatus requires a minimum of attention, and gives a maximum of results, the saving in labor alone amounting to a large sum each year. The output of the press is increased 20 per cent. over the old mechanical drive, and in running off an edition these two presses can give twenty minutes' start to any other two presses in the building, the latter being operated by more men, and can beat them out on the edition. In case of a slight accident, where the presses start at the same time as the old mechanical drive presses, it will be seen that they can gain the time lost with ease. There is no breaking of paper, no clogging up, no confusion and no injuries to men, and when an edition is started on either one of these two presses it is always finished ahead of time.

Ice Scenery at Niagara Falls.

ONE of the most interesting sights in Prospect Park, Niagara Falls, during the prevalence of the ice scenery, was the immense amount of ice that had fastened itself on the electric light wires in the vicinity of Prospect Point. In one place near

SNOW AND ICE-LADEN LINES, NIAGARA.

the inclined railway building the wires had an unusual weight to sustain owing to the fact that they were very near the falls, and the spray descended upon them in clouds, freezing as it fell. At this point the circumference of the ice on a single wire was between two and three feet, while further back in the grove the wires were also heavily coated. Considering the weight of the ice it was deemed remarkable that the wire supported it without breaking in two in many places. In one place the weight of the ice pulled the wire loose from its supports and hung in a festoon between the trees, forming an attractive picture well portrayed in the illustration. The size of the wire used in the park is No. 6.

Power Plant at St. Anthony Falls, Minn.

The equipment of the power house at the lower dam of the Falls of St. Anthony, at Minneapolis, Minn., is about to be completed, and the necessary arrangements have been made by the St. Anthony Falls Power Co. with the General Electric Co., which manufactured and installed the plant now in operation. The hydraulic work and the power house were finished in the spring of 1898, and five three-phase alternators of 700 k. w. each and two direct current generators of the same capacity with the necessary rotary converters and static transformers were installed. The full equipment of this power plant as originally laid down contemplated the use of eight alternators and two direct current machines of the total capacity of 10,000 h. p. The present plant has been in full operation since May of last year, the current being used to drive the street and interurban railway systems of the Twin Cities Rapid Transit Co., which operates the electrical railways of Minneapolis and St. Paul.

The additional equipment will consist of three 700 k. w. three-phase revolving armature alternators, with rotary converter, step-up and step-down air blast transformers, and switchboards for the generators and converter. The installation of this machinery will raise the generating capacity to the 10,000 h. p. originally contemplated.

Some Recent Developments in the Gas Engine Field.[1]

BY EDWIN RUUD.

GAS engine engineering is a peculiar and difficult line, probably one of the hardest branches in the entire mechanical field of to-day. This you will understand when you stop to consider that the temperature in the cylinder during the explosion periods is a dazzling white heat, and that many parts are exposed to this high temperature. Add to this the different behavior of the various kinds of gases and that the whole process is going on within enclosed doors, so to speak, where you have very little chance to see what is taking place, and you can imagine the difficulties of the problem. It is a wonder that an engine can be made to run satisfactorily under such conditions. It requires a constant association with the subject in order to fully understand and to be able to overcome the numerous difficulties which present themselves. The difficulties increase with the size of the engine, due to the fact that the heat problem becomes more and more troublesome to solve. It is for this reason that the gas engine has not made much headway in the larger sizes. Also, few men have been willing to experiment in large sizes of gas engines in view of the uncertainty and the abnormally heavy expense connected with the development of say a 1,000 B. h. p. gas engine. I shall later on say a few words touching upon large size gas engines. I shall in the course of this short talk confine myself to two classes of engines now in use, and shall endeavor to explain or make clear to you the workings of these two kinds of prime movers. This classification is made with regard to the mode of regulation, the cycle being the same in both, the "Otto" or "Beau de Rochas;" in fact, this cycle is about the only one used to-day commercially. I shall try to point out the advantages and the disadvantages of these two classes in order. In the so-called "hit and miss" gas engine which has been made exclusively until recently the governing is done so that one or more charges may be cut out and that the engine can either take in a full charge of gas and air or omit the gas altogether, as the gas valve stem is only in position to be operated by a cam when the engine is running at or below normal speed.

Thus you will readily understand why the "hit and miss" type of engine is not suitable where a uniform speed is required, and but few of this type are running in connection with dynamos for lighting purposes.

The "hit and miss" gas engine must have heavy fly-wheels, and a heavy balance wheel is usually mounted on the jack shaft in order to obtain an approximately steady speed. I have even seen some outfits of this kind having a small fly-wheel on the armature shaft. This arrangement as you will see, takes up a great deal of floor space. The flapping of the engine belt due to the irregular motion of the gas engine together with the ordinary hissing sound from the two belts makes the plant a very noisy one. The variation in the voltage on a 100-volt circuit is generally from 3½ to 4 volts during the cycle. That is, when the engine may take in a few charges successively, the voltage is steady and rising, but when the engine omits one or more charges, a momentary variation in speed is the result and fluctuation is apparent in the lights.

This introduction of two extra belts, shafting and masses to move, causes quite a loss in power. The power absorbed by the

[1] Abstract of a paper read before the Technische Verein, Pittsburg, Pa.

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two belts will be approximately 7 per cent., and the jack shaft about 3 per cent., making a total of about 10 per cent. taken up by the extra machinery. Even with this auxiliary machinery, the speed of the dynamo is unstable and the service unsatisfactory. This type of engine is therefore limited to do work where steady speed is not necessary or required. This type of engine has one advantageous feature, namely, that the charge is always ignited under the same pressure, and hence the actual work done by the exploding gases in a given cycle is practically the same for full load as for no load.

Recent developments have proved that the modern type of gas engine is admirably adapted for electric lighting, as its economy is very high and its speed regulation in a type to which I will refer has been made as good as that of a first-class steam engine. It is the electric business which has stimulated the experiments in the direction of producing a gas engine which would be suitable for incandescent lighting work. It is in contrast to the "hit and miss" type and has the armature on the crank shaft, direct-coupled or directly belted precisely as its brother, the steam engine. This is shown in Fig. 1.

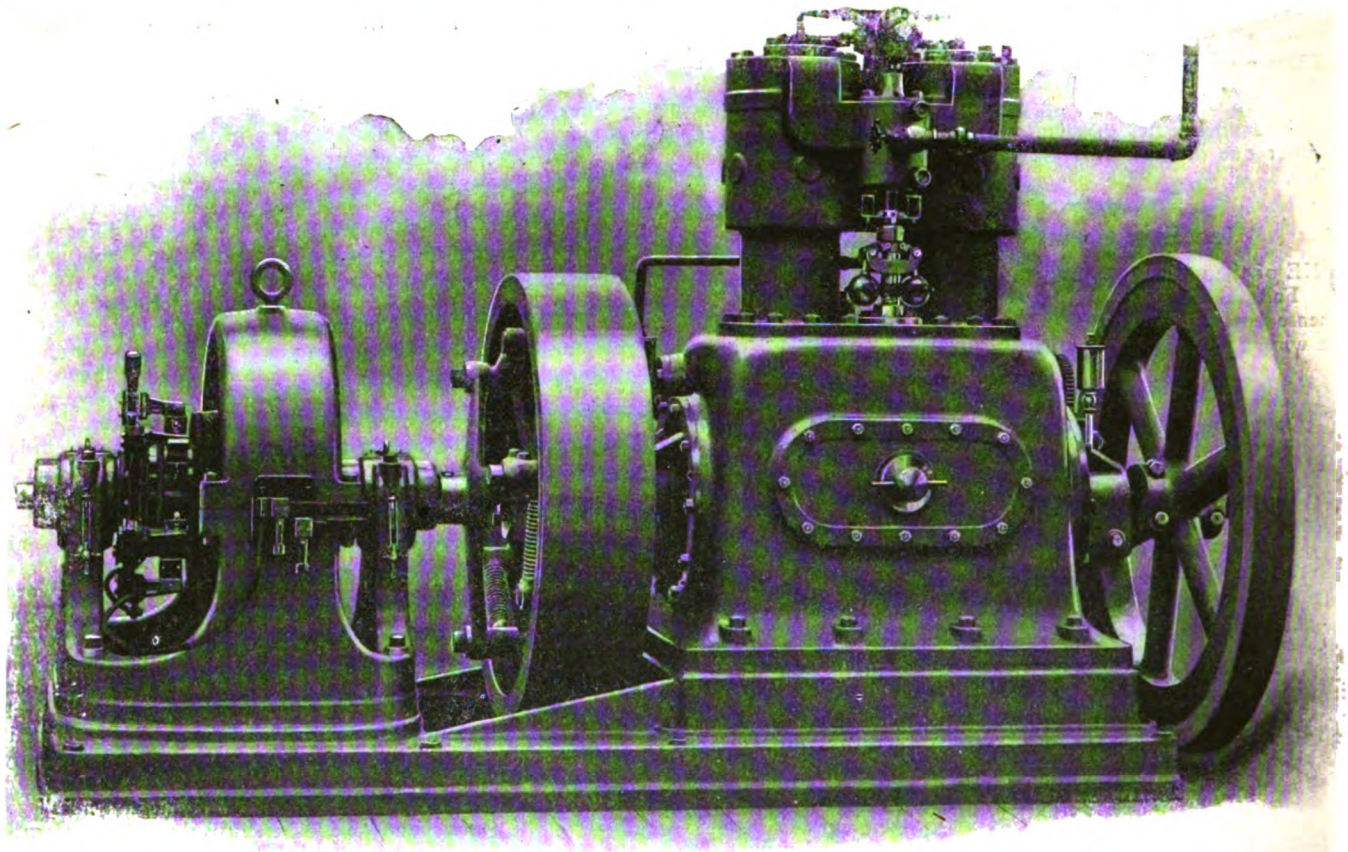

FIG. 1.—WESTINGHOUSE GAS ENGINE DIRECT CONNECTED TO A GENERATOR.

The mode of governing is similar to that of the steam engine and that for picking up a heavy load it is even in a better position. All charges being proportioned to the load if the load is suddenly thrown off, there is one heavy charge already locked in, which cannot be removed, although the governor acts instantly, and there may be another under way which may be partially reduced by the action of the governor. This tends to speed up the engine a trifle above the normal, but because of the fly-wheels this tendency is so slight that it can be ignored in practice, besides there are very few plants subjected to throwing off the entire load at once. Having described both classes, I shall now dwell upon the gas consumption, and what I say in this respect is applicable only to the Westinghouse Gas Engine.

GAS CONSUMPTION.

The gas consumption in all engines varies with the kind of gas used and also with the size of the engine up to certain limits. The average performance of the Westinghouse Gas Engine, say from 20 h. p. upwards, is 10.5 to 12 cubic feet of natural gas per B. h. p. hour. According to numerous tests with the Junker Colorimeter, I have found that the average heat value of natural gas is 1,000 B. T. U. per cubic foot. That is, the engine requires 10,500 to 12,000 B. T. U. for each B. h. p. hour, giving a heat efficiency at the shaft of 25.4 per cent. and 21.3 per cent., respectively. The above are not fancy figures, but represent the every-day performance of the engines while in the hands of the customer.

The indicator cards in Fig. 2 taken from a Westinghouse gas engine will give the reader an excellent idea of the governing action under overload, rated load, half load and no load.

Some special engines have been built which have given much better results than the above mentioned and I have in mind a special 125 B. h. p. gas engine, which when tested gave the phenomenal economy of 9 cubic feet per B. h. p. This would give an efficiency at the shaft of 28.7 per cent.

These are good results, but they are not as good as may be expected and I firmly believe that the every-day performance of a gas engine will within a short time reach 33⅓ per cent. Some experiments are being made along this line now and with reasonable show of success.

WATER CONSUMPTION.

It is necessary in a gas engine to have the cylinders and all the parts exposed to the heated gases water cooled in order to prevent overheating of the different parts. This is generally done by letting a stream of water flow through the cylinder jackets. As the public at large seems to be ignorant as to the water consumed per B. h. p. hour, I shall here state the amount of water required. In winter the consumption of water may be put down at about 30 pounds and in summer 38 to 40 pounds per B. h. p. In places where water is expensive, this need not be wasted, as by putting up a tank or tanks according to the size of the engine, the loss of water need not be more than a few gallons per week, or just as much as the evaporation of water from the surfaces of the tanks would amount to. Another way of cooling is by the use of a cooling tower. The water is pumped from a well through the water jackets of the gas engine cylinder, where it becomes heated, and from there over to the top of the cooling tower, to again return to the well at about atmospheric tempera-

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ture, to be used over and over. This mode of cooling produces a greater loss of water than that of the tank system, but it is almost always used in connection with large sized engines. Not long ago I made some tests for the purpose of determining the amount of water necessary for cooling and to determine the heat lost through the same.

It was found that 5,121 B. T. U. went out in the cooling water, 2,922 B. T. U. was converted into work, and 2,957 B. T. U. must

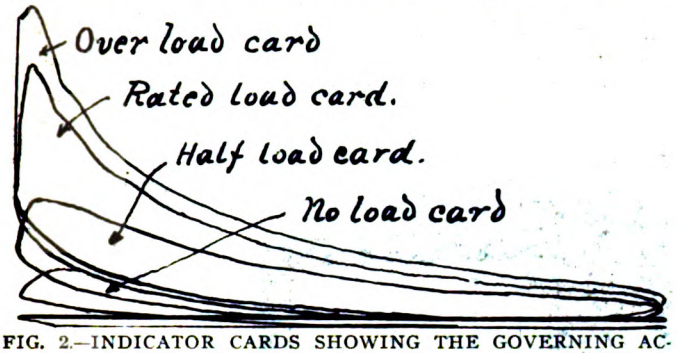

FIG. 2.—INDICATOR CARDS SHOWING THE GOVERNING ACTION OF A WESTINGHOUSE GAS ENGINE.

then be the approximate amount of heat which went out through the exhaust and lost by radiation.

From this you will see that there is still room for improvement towards efficiency. The bulk of the loss is in the cooling water.

THE FUTURE OF THE GAS ENGINE.

Until recently the gas engine has been made in comparatively small sizes only, and as I have before stated, only for what you may call rough work, that is, where steadiness of speed was not essential. The largest engine in this country, made commercially, was only 100 h. p., having two cylinders and of the "hit and miss" type. The public looked upon the gas engine as a sort of a "freak," and did not take very kindly to it. The introduction of electricity, calling for prime movers, also stimulated the demand for a cheap and convenient motor, and this, more than anything else, has brought the gas engine forward. In the early part of the spring of 1898, an engine of about 650 B. h. p. was completed in the works of the Westinghouse Machine Company, shown in Fig. 3. This engine is of the three cylinder type and has a speed of 150 revolutions per minute. After it was thoroughly tested on the testing foundation, it was erected in the power house of the Westinghouse Electric and

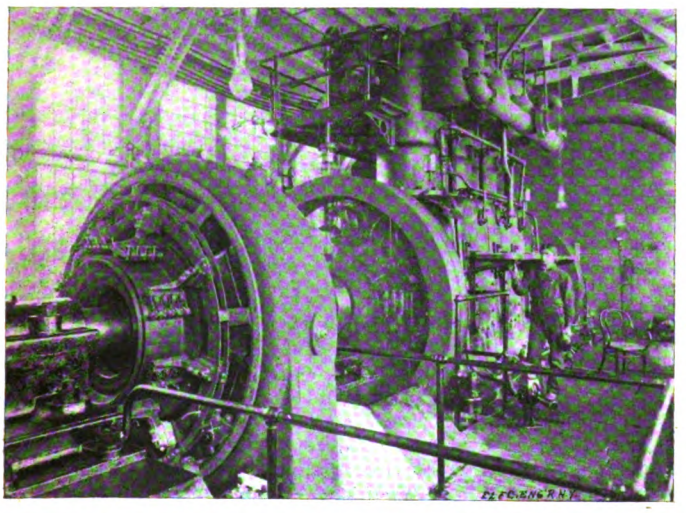

FIG. 3.—650 H. P. THREE CYLINDER WESTINGHOUSE GAS ENGINE D. C. TO A GENERATOR.

Manufacturing Company, where it is running in regular commercial service of a severe character. The engine is direct-connected to a suitable generator and runs in conjunction with one or two steam engines, according to the call on these units for electric current. This engine is by far the largest gas engine in the world and it is pleasing to record that this large gas engine was built in Pittsburg. But this engine will not long enjoy the distinction of being the largest one. The Westinghouse Machine Company are now making drawings and patterns for a 1,500 B. h. p. gas engine. This engine is also of the three cylinder type, and it is designed to run 100 revolutions per minute. Remarkable economy is expected from this engine, as every possible care is being taken to make it a model of modern gas engine engineering. It would not be surprising if this engine developed a B. h. p. per every 8½ cubic feet of natural gas consumed per hour or 8,500 B. T. U. per B. h. p. hour. This would give a heat efficiency of 30 per cent. at the shaft. When gas engines can be made of such efficiency in large units, they will undoubtedly compete successfully with the most modern steam engine.

A gas engine of such size and efficiency will run day in and day out on less than one pound of coal burned in a good produce gas plant per B. h. p. hour. This includes banking of fires and the like losses. It would have to be a high-grade steam engine and boiler plant if it should regularly be able to produce a B. h. p. for two pounds of coal per B. h. p. hour, twice the amount of fuel required by the gas engine under similar conditions. From the foregoing you will see that the gas engine is no longer limited to special power purposes. It can hold its own as a prime mover, and can be used for almost all purposes for which the steam engine can be used. But all this has not been accomplished in a day. It is now 108 years since the first patent on an explosive motor was taken out by John Barber, and from that time on it may be seen that great improvements have been made.

Fuel Gas for Electrical Works.

THAT fuel gas should displace coal and even crude petroleum in all heating operations which require an exact, constant, and uniform application of heat is so generally conceded by mechanical engineers, that its adoption in shops and factories mainly depends upon the cost of such gas per 1,000 feet, and wherever its cost does not greatly exceed that of other fuel for any given work, gas must be preferred on account of superior efficiency.

The question of its use must, however, be considered in connection with the fact that no artificial gas can be made cheap enough to be used wastefully, and hence cannot be used to advantage by introducing it into old furnaces, forges, and ovens originally built for solid fuel or petroleum. This has been done with natural gas, as long, at least, as it was plentiful, but for the much dearer artificial gas suitable furnaces must be provided, carefully designed for each special purpose.

Draught cannot be utilized to supply air for combustion or to distribute the heat. Radiation, or the heating of unused space must be limited to the minimum, and, generally speaking, the heating operations of the factory must be systematized, so that furnaces, forges and "heating machines" can be used to the best possible advantage, without waste of fuel, each doing only the class or kind of work for which it was designed.

A complete and well arranged outfit of gas furnaces will prove exceedingly profitable even if the first cost of the installation is comparatively high, while makeshift arrangements designed without the requisite experience will prove wasteful in fuel consumption and unsatisfactory in operation, even with the cheapest fuel gas that can be provided. Gas furnaces and heating machines are, like modern machine tools, expensive but profitable.

It is with pleasure therefore that we call the attention of electrical manufacturers to the fuel gas system of the American Gas Furnace Company, who are backed by an experience of nearly 20 years in this class of work. Their success is attested by unimpeachable testimonials from first-class manufacturers, and the value of their work has been recognized wherever exhibited, and has the indorsement of the Franklin Institute, of technical schools and other competent judges.

Among their many customers are the S. S. White Dental Manufacturing Company, whose exceedingly varied productions of dental tools, machines, instruments, and artificial teeth—famous throughout the world among dentists—requires probably the greatest variety of heating devices needed in any one industry, and it certainly speaks well for the American Gas Furnace Company, that they have adopted this system in their three large factories, in each of which the fuel gas is generated by their gas machine, and complete outfits have been provided which displace every other means of heating heretofore employed in mechanical heating.

They have also fitted out the works of the Putnam Nail Company, Neponsett, Boston, Mass.; the Pope Manufacturing Com-

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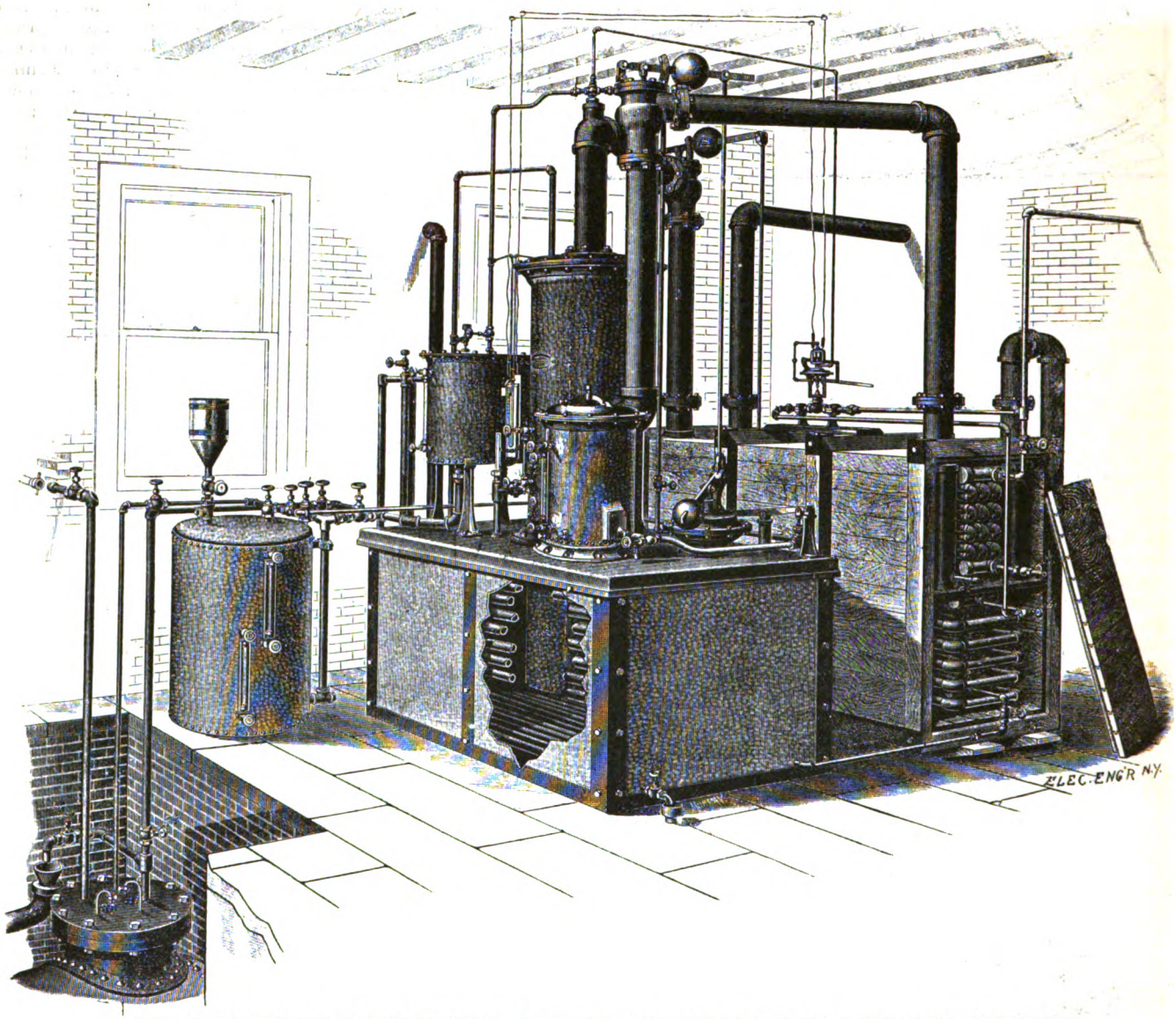
pany's tube works at Hartford, Conn., and their bicycle and motor carriage works. The Elgin National Watch Company, Elgin, Ill., has also long since adopted the system in all its work, and more recently the American Gas Furnace Company has done very satisfactory work for electrical manufacturers, including the Sprague Electric Company's factory at Bloomfield, N. J., the New York & Ohio Company, of Warren, O., and the General Electric Company, of Harrison, N. J.

Other large manufacturers of dynamos, motors, electrical instruments and incandescent lamps, are using partial or complete outfits for carbonizing lamp filaments, annealing armatures, magnets, etc., and for brazing, case hardening, soldering, melting, enameling, and other heating operations incident to electrical work.



NEW AMERICAN OIL GAS MACHINE No. 3, PLACED AND CONNECTED IN A SEPARATE GAS HOUSE.

Since the providing of a thoroughly reliable fuel gas supply is the first step to be considered in equipping a factory with gas furnaces, we herewith illustrate "The American Oil Gas Machine," deeming it to be well suited to supply the needs of electrical manufacturers, and without going into a detailed description of the construction of the machine or the process which can be obtained in pamphlet form on application, we would say that it is the principal part of the fuel gas system of the American Gas Furnace Company, whose other parts consist of the furnaces, automatic heating machines, and other appliances, which, with the "Reichhelm pressure blower," collectively form a complete system for the generation and utilization of gas as fuel for manufacturing purposes.

The leading idea in this system is to make gas without a particle of waste, by converting the total of a given quantity of naphtha into gas without the least waste or by-product; to make all heating operations by gas more certain, uniform, effective and economical than can be done by other means, and to make the operation of the system so perfectly safe that insurance rates cannot be affected by its introduction.

Their claim that naphtha gas is the cheapest and at the same time the best fuel gas now in practical use, where the required amount of fuel would be anywhere from 5,000 to 50,000 feet of city gas per day, seems to be well founded, because the gas is made substantially without any labor cost, the process being performed automatically, and while it may be an open question whether this gas would be economical in such works as rolling mills, rail mills, and other large works, where the consumption would reach hundreds of thousand feet, it seems evident that for a limited consumption, such as will cover the requirements of electrical works, water or producer gas cannot compete with it on account of the labor cost involved in making it, and which can pay for itself in industries where the consumption is much greater.

In determining upon the gas producer best suited for any one factory, the first question to be decided therefore is the approximate quantity of gas required per day. This can be very nearly approximated by taking regular illuminating gas as a criterion, or standard measure, and comparing with it the other fuels heretofore used respecting caloric efficiency.

Good practice and experience have determined that from 9,000 to 10,000 feet of illuminating gas containing 675 heat units per cubic foot are equal in heating power to one ton of coal, 140 gallons of crude petroleum, or 50 gallons of naphtha gasefied.

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In considering the adoption of water or producer gas, it must be remembered that the price of such gas per 1,000 feet is only one factor in the calculation, the other being its caloric efficiency or heating power, which, of course, depends upon the number of heat units it contains. Ordinary water gas and producer gas mixed contain not to exceed one-third as many heat units as the regular illuminating gas. It will therefore require from three to four times as much of such water and producer gas for a given amount of heat.

In some plants a better quality of fuel gas is made, but it cost per 1,000 is correspondingly increased by the greater heat required to make it. If, as in some manufacturing towns, fuel gas is sold for 25 cents per 1,000, it is well to remember that about 3,000 feet must be injected into the furnaces to produce the heat obtainable from 1,000 feet of good illuminating gas, and the price per 1,000 feet should therefore be multiplied by three.

For a factory whose consumption would probably not exceed 90,000 feet of fuel water gas, which would be equal in heating power to 30,000 feet of city gas, it can be readily ascertained from the builders of such plants that the cost of installation of a factory plant is prohibitive, because the interest added to the cost of making the gas, which entails constant labor and attention of special help, would bring the cost of the gas very far beyond the figure for which naphtha gas can be supplied.

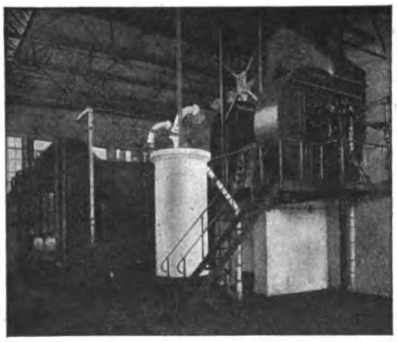
Two distinctly novel features are claimed for the fuel gas system of the American Gas Furnace Company. The first is that it is the only system in practical use by means of which the total of a given quantity of fuel is converted into gas without a particle of waste or by-product, and the second interesting claim is, and it seems well founded, that the manner of injecting the gas into the furnace is a complete reversal of the old famous Bunsen system.

In the Bunsen system the gas pressure is used for the induction of the air needed for combustion. In that of the American Gas Furnace Company, the air pressure, which is under perfect control, is employed to inject the gas, both systems being alike in one thing only, namely, that a mixture of gas and air is effected.

The importance of this reversal of the Bunsen system can readily be appreciated when it is remembered that the air pressure can be increased or diminished at will, and that the mixture can be injected under any desired pressures, and varied in any possible proportion, and hence the very high efficiency for which the gas furnaces and heating devices of the American Gas Furnace Company, have become famous, not only in this country, but throughout Europe. They are the "modern machine tools" for systematic and correct heating.

Mechanical Draft Versus Chimney Draft.

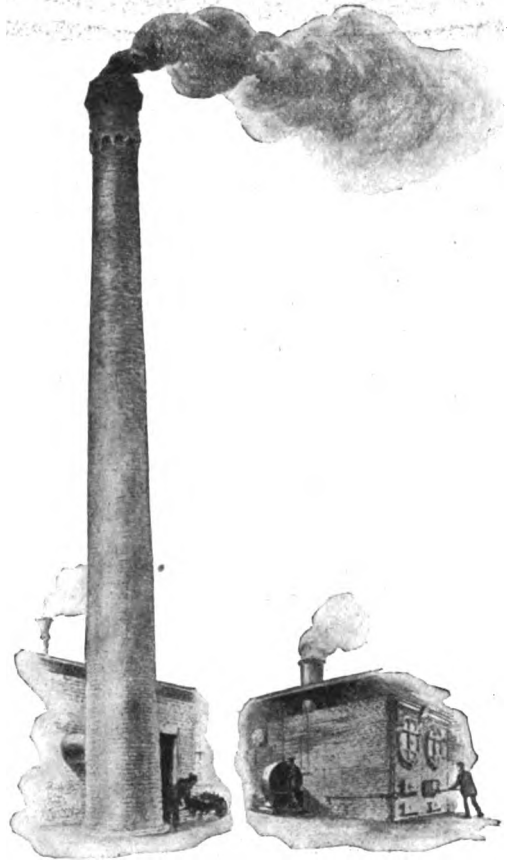
"MECHANICAL DRAFT, What It Is and What It Does," is the suggestive heading of one page of Bulletin J, just issued by the B. F. Sturtevant Company, Boston, Mass. As stated "It is draft mechanically produced by means of a fan, and may be introduced either as forced draft, by which the air under pressure is delivered to the ashpits, or, as induced draft, arranged to draw the gases through the fan and to maintain a partial



INDUCED MECHANICAL DRAFT APPARATUS AT HOLYOKE, MASS.

vacuum within the furnace. The method to be adopted must of necessity depend upon the existing conditions. It does what an ordinary chimney is incapable of doing. Its cost is from 20 to 40 per cent. of that of a chimney; its intensity permits of the burning of finely divided or low grade fuel; it makes possible the utilization of the heat of the flue gases which a chimney wastes in producing draft; it is independent of the weather; is automatically regulated to maintain constant steam pressure, prevents smoke, increases the capacity of an existing plant, and serves as an auxiliary to a chimney already overburdened; it saves space, and is portable."

The illustration which is shown herewith of a chimney, and a fan applied for draft production, presents most graphically the relative sizes of these two means of producing draft. They are



VIEW OF BOILER HOUSE, SHOWING RELATIVE SIZE OF CHIMNEY AND MECHANICAL MEANS OF DRAFT PRODUCTION.

both drawn to the same scale, and are both capable of operating the same sized boiler plant. The chimney is fully 16 times as high as the fan; it is not portable, is almost valueless when abandoned, while the fan may be readily moved and is usually a valuable asset.

The smaller engraving presented herewith serves to illustrate the induced method of application. This plant is at the Holyoke Street Railway Company, of Holyoke, Mass., and the mechanical draft apparatus consists of two fans equipped with direct-connected engines, automatically regulated to maintain constant steam pressure.

The bearings are water cooled, so that the gases can be handled with impunity, and each fan in this case is of sufficient size to operate the entire plant. The short stack extends just above the boiler house roof. An arrangement like this naturally lends itself most readily to the introduction of a fuel economizer, whereby the wasted heat of the gases, required to produce draft for the chimney, may be utilized when the fan is employed.

Recent tests of nine different boiler plants equipped with mechanical draft apparatus and economizers showed an average fuel saving of 14.6 per cent.

Materials for Coherers.

The noble metals—platinum, gold and silver—give practically no coherer action. Iron gives good results, especially after a short exposure to air. Copper, immediately after filing, shows no change of resistance. After five hours a slight coherer action is observed, and in three weeks the resistance may rise to 300,000 ohms, which falls to 10 ohms under the influence of electric radiation, and rises to 187,000 ohms on concussion. Neither exhaustion nor heating have any influence upon a tube containing aluminum filings. In tubes containing nickel, iron.

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copper or zinc, heating leads to a diminution of the resistance, which in zinc is probably due to sublimation.—E. Dorn, Wied Annalen.

OBITUARY

John Kruesi.

JOHN KRUESI, the chief mechanical engineer of the General Electric Company, died on Feb. 22 last at his home, in Schenectady. His death, which resulted from an attack of grip, occurred quite suddenly, after an illness of only three or four days. The funeral services were held on Saturday afternoon, Feb. 25, and were very largely attended, not only by the officers, heads of departments and employees of the General Electric Company, and by residents of Schenectady generally, but also by many of Mr. Kruesi's old associates in the early Edison days of Newark and Menlo Park. Among those who traveled long distances specially to attend the funeral were Messrs. Thomas A. Edison, Charles A. Coffin, president of the General Electric Company; Samuel Insull, president of the Chicago Edison Company; Charles A. Batchelor, of New York; Sigismund Bergmann, of New York; F. P. Fish, general counsel of the General Electric Company; J. W. Lieb, Jr., general manager of the Edison Electric Illuminating Company of New York; W. S. Barstow, of the Brooklyn Edison Company; S. Dana Greene, general sales manager of the General Electric Company; C. T. Hughes, manager of the New York office of the General Electric Company; W. E. Gilmore, of Orange, N. J.; Wilson Howell, of Harrison, N. J.; John Langton, of New York; F. R. Upton, of Orange, N. J., and Martin Insull, of Chicago.

JOHN KRUESI.

There were two services, both conducted by the Rev. A. C. Sewall, Mr. Kruesi's pastor, the first in the First Reformed Church, which was attended by all except the family, and the second in Mr. Kruesi's house, where the family and personal friends, including those already mentioned, were present. Immediately after the services at the house the body was taken to Vale Cemetery, Schenectady, for interment. The pallbearers were Messrs. Samuel Insull, president of the Chicago Edison Company; Charles Batchelor, of the New York Edison Company; A. J. Pitkins, vice-president of the Schenectady Locomotive Works; G. E. Emmons, general manager of the General Electric Company's Works at Schenectady; E. W. Rice, Jr., 3d vice-president of the General Electric Company, and John D. Remer, of Schenectady.

John Kruesi was born in Spercher, Canton Appenzell, Switzerland, in 1843, and went to work in a machine shop at an early age. He found his way to Paris in 1867, the year of the Exposition, and remained there, working in various mechanical industries until the outbreak of the Franco-German war in 1870. He then went to London, where he stayed for some months, and finally resolved to make his home in the United States, which he reached in December, 1870.

An old acquaintance of his, August Weber, a fellow-countryman, whom he had met at the Paris Exposition, was then working for the Singer Sewing Machine Company at Elizabeth, N. J., and it was with the same company that Mr. Kruesi first found employment. During the two years that he stayed in Elizabeth, he showed that he had a firm grasp of mechanical problems and their solution; and in 1872 he had full charge of a new automatic machine for making needles.

At this time Mr. Thomas A. Edison, in partnership with Mr. Unger, was manufacturing stock exchange tickers and telegraph instruments, upon which he had taken out patents, in Ward street, Newark, and in June, 1872, Mr. Kruesi began to work for him. The panic of 1873 kept Mr. Edison and his employees hard at work to make a living between that year and 1875, but in the latter year Mr. Edison felt strong enough financially to open a second shop for purely experimental work in Green street, Newark. One of the first men whose services he was able to utilize in this field was John Kruesi, and for the next five or six years, either in the Green street shop or at Menlo Park, Mr. Kruesi was practically Mr. Edison's machine foreman, not only designing and making special apparatus to fit the conditions which Mr. Edison required, but also often making the special tools necessary for newly invented apparatus.

During these five years—from 1876 to 1881—Mr. Edison was busy with the phonograph, improvements on the Bell telephone, incandescent electric lighting, electric railway experiments, and, above all, the subdivision of the electric current necessary to make incandescent lighting successful as a commercial venture. During this period Mr. Edison's power of doing without sleep and of working day and night for several days in succession tried the endurance of the strongest of his associates. Mr. Charles A. Batchelor, who was closely connected with Mr. Edison at this time, says that of all the group of men who worked at Menlo Park, Mr. Kruesi was the most tireless, as well as being one of the most fertile in suggestions to overcome the difficult obstacles to success which were constantly arising.

The first phonograph was made by Mr. Kruesi in Menlo Park, in 1877, from a rough sketch made by Mr. Edison, who is authority for the statement that neither he nor Mr. Kruesi had any great expectation of a successful result, and that both were utterly astounded when the tinfoil gave out audible words. This phonograph is now in the Patent Section of the South Kensington Museum, London.

In 1881 incandescent electric lighting had passed beyond the stage of experiment, and the Electrical Tube Company was formed with Mr. Edison as president, Mr. Samuel Insull as secretary and Mr. Kruesi as treasurer and general manager, to make and lay down underground electric conduits in New York City and elsewhere. The first shops of this company were in Washington street, New York City, and there Mr. Kruesi, often with his own hands, turned out the early conduits which were laid down in the lower part of New York City—the first two-wire conduits for lighting or power to be placed in service in any part of the world. Nearly all the early patents for improvements in underground conduits bear Mr. Kruesi's name as inventor.

The Electrical Tube Company, after moving its shops to Bridge street, Brooklyn, for a short time, was finally absorbed by the Edison Machine Works, whose shops were then in Goerck street, New York, in 1883. Mr. Charles A. Batchelor was then general manager of these works, and Mr. Kruesi became his assistant. In 1886 the Edison Machine Works were removed to Schenectady, Mr. Samuel Insull becoming the general manager, and Mr. Kruesi retaining his place as assistant general manager. Mr. Insull himself gives Mr. Kruesi credit for having designed and constructed all the shops which were erected while he was general manager—that is, from 1886 to

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1892. "When we went to Schenectady," said Mr. Insull, "we had only 200 employees, and in 1892, when the General Electric Company was formed by the union of the Edison and Thomson-Houston companies we had 4,000 employees, so that Mr. Kruesi had to make provision for this large increase in the comparatively short space of six years." In fact, the works, as they now stand, are Mr. Kruesi's monument.

In 1892, Mr. Kruesi succeeded Mr. Insull as general manager, and in this capacity had charge of the Schenectady Works until 1896, when he was appointed chief mechanical engineer to the company. During his long connection with Mr. Edison and the various companies which were his successors, Mr. Kruesi made many important improvements and inventions in machine tools. He was also, from his thorough understanding of the strong and weak points of apparatus, a salesman of more than average ability, when his services were wanted in this capacity. He had a large and varied electrical knowledge, particularly in his keen recollection of numerous experiments which had turned out failures, and of the reason why success along some particular line could not be achieved. Most of all, he was prized by troops of friends, friends for the absolute honesty of every side of his character.

Mr. Kruesi was a widower, his wife having died in January, 1897. He leaves a family of eight children, the eldest of whom is now in England.

Mr. Kruesi's will, which was read after the interment, appointed Mr. Thomas A. Edison, Mr. Samuel Insull and Mr. Charles A. Batchelor as executors.

Edwin S. Carpenter.

We note with regret the sudden death of Mr. E. S. Carpenter, who died in this city at the age of 37. He was the assistant treasurer of the Westinghouse Electric Manufacturing Company, with whom he had been associated for seven years. His death was very sudden, and it is understood he was on the point of marriage, thus rendering the event very sad. His marked legal and business ability and sterling character, shown in the discharge of his duties, won for him the respect and confidence of his company and the warm personal regard of his associates.

Baron De Reuter.

Paul Julius Reuter, Baron of the Duchy of Saxe-Coburg and Gotha, and director of Reuter's Telegram Company, died at Nice on Feb. 25, in his eighty-third year. He was born at Cassel, Prussia, 1816. From the opening of the first telegraph line in Europe, between Aix-la-Chapelle and Berlin, in 1849, he became interested in the electric telegraph system. He acquired an interest in the different lines as they were opened, and in 1851, when the cable between Dover and Calais was laid, he opened his chief office in London. He had before this been naturalized as a British subject. Mr. Reuter immediately began to establish agencies in different parts of the world and to supply the British press with news. Similar organizations were established by him in America, India, China, Australia and all the Continental States. In 1865 he turned over his business to a limited liability company. He retained the position of manager, and in the same year he obtained a concession for the construction of a submarine cable between England and Germany. Mr. Reuter also obtained a concession from the French Government for the laying of a cable between France and the United States. This was laid in 1869, and is operated in conjunction with the Anglo-American Telegraph Company. The title of Baron was conferred on him by the Duke of Saxe-Coburg and Gotha in 1871.

In 1878 Baron Reuter retired from the managing directorship of Reuter's Telegram Company, but still retained a place as a member of the Board of Directors. The Shah of Persia granted him in 1872 a concession conveying the exclusive privilege of constructing railways, working mines and forests, making use of other natural resources of the country and farming the customs. Baron Reuter attempted to render this monopoly subservient to British interests, although not excluding other nations. He received the support of the British Government, but owing to the difficulties encountered the concession was annulled in January, 1889. The Baron received instead the concession of the Imperial Bank of Persia.

PACIFIC CABLE SOUNDINGS are to be made by the "Ranger" between Hawaii and Manila.

PERSONAL

Mr. R. H. Hassler.

An evidence of the growing importance of electric automobilism is seen in the engagement of Mr. R. H. Hassler by the well-known Indiana Bicycle Company, of Indianapolis, who have lately engaged extensively in the production of electric vehicles and other "horseless." This gentleman is about 27 years old and was a graduate in 1892 from the Ohio State University in the electrical engineering course. He was three years in the experimental department of the Westinghouse Electric and Manufacturing Company, at Pittsburg. He then engaged in business for himself at Dayton, O., for a short time, giving it up to accept a position with the Electric Vehicle Company in New York City, in charge of tests. He has now joined the Indiana Bicycle Company as electrical engineer, assigned to the motor vehicle department. In his earlier work he gained the critical esteem of Mr. C. F. Scott, of the Westinghouse Company, and has now opened to him a career of much importance and opportunity.

M. GEORGE PELISSIER, electrical engineer of the electrical section of the Paris Exposition of 1900 is stopping a few days in this city on his way home to Paris. He reports work progressing rapidly on the Exposition.

MR. JAMES F. BUTTERWORTH, of London, has arrived in this city and expects to spend some time in the United States. Mr. Butterworth is on the lookout for novelties and inventions to take back with him for exploitation abroad and will be glad to hear from interested parties; care of this office.

MR. J. H. MANNING, former mayor of Albany, N. Y., has succeeded the late General S. E. Marvin as president of the Hudson River Telephone Company.

MR. T. A. EDISON admitted in a recent interview that he is working on a fac-simile telegraph. He is also said to be experimenting with automobiles, a subject in which he has been interested for some time.

MR. HENRY B. CUTTER, of Philadelphia, (I. T. E.), was noticed in Chicago last week.

MR. F. C. PHILLIPS, manager of Elwell Parker Electric Company, Cleveland, O., called at the office of The Electrical Engineer, in Chicago, this week. Mr. Phillips has been in town about a week on some important business deals.

SOCIETY & CLUB NOTES

American Institute of Electrical Engineers.

Secretary Pope notifies members of the Institute that they should send in their nomination blanks filled out as directed, to the secretary before March 1. From these returns the council will select candidates for the official ticket at its meeting March 22. Those who have failed to receive the blanks, or have mislaid them, will be supplied with duplicates upon application.

New York Electrical Society.

The following members were elected at the meeting of the society held on the 14th inst.: E. S. Keefer, Western Electric Co., Bethune street, New York City; Walter F. Wells, Manhattan Electric Light Co., 80th street and East End avenue, New York City; Robert O. Bacon, The Maintenance Co., 220 Broadway, New York City; Edward Heaton, 1 Ferry street, Port Richmond, S. I., New York; Harry Robert Benda, 355 West 24th street, New York City; Marcus B. Waterman, 179 Lefferts place, Brooklyn, N. Y.; J. A. Lynch, New York Telephone Co., 372 Pearl street, New York City; Bartow V. Van Voorhis, 2d, Crocker-Wheeler Electric Co., Ampere, N. J.; Henry Drucker, 44 Vanderveer street, Brooklyn, N. Y.; Harry N. Ramsey, 1062 Lexington avenue, New York City.

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Looking Backward.

BY HERMAN A. STRAUSS,

Gen. Mgr. "The Elec. Engr. Inst. of Corr. Instn."

EVERY human enterprise that looks to true and lasting success must be built upon a groundwork of honesty of purpose. The structure itself must be designed upon broad and liberal lines—its conception must be the result of deep thought and its erection must have involved painstaking effort, indefatigable labor and persevering application. If these factors are present from its inception, a successful outcome is generally a foregone conclusion.

We may truthfully state that The Electrical Engineer Institute of Correspondence Instruction was designed along such lines and nothing that its founders could do to increase its usefulness and its efficiency, as an instrument of honest merit in the field of engineering education, has been neglected.

Designed to aid those thousands of ambitious workers whom circumstances have deterred from participating in the benefits of a college education, the Institute has met, it is now apparent, a most decided need of the times.

This is strikingly shown by the many letters of approbation received from students enrolled during the past year throughout the civilized countries of the globe. From such distant communities as the English, Dutch and German settlements of Africa, Asia and Australia as well as from the mother countries of Europe and from every State and Territory in the Union have come applications for enrollment in some one of the various courses taught by the Institute.

In almost every instance has the student thus enrolled expressed his satisfaction and pleasure at the opportunity afforded him of acquiring from an absolutely reliable source the best teachings of contemporaneous talent, as well as a proper exposition of the fundamental truths of the science.

The great labor, expense, conscientious endeavor and deep responsibility which the conception, consequent organization and execution of a design so great as this have involved, may perhaps not be fully realized by the student or the layman, but to the thinking man this fact cannot fail to have been evidenced by the result achieved. Where such general satisfaction is expressed by all of the participants in any human enterprise and where every transaction taking place between the purveyor and the consumer carries upon its face the stamp of truth and fair dealing it is but just to grant that the student has not gone astray in entrusting his education to such an institution.

The honesty of purpose which has animated the founders of the Institute has not only shown itself in the endeavor and successful achievement of obtaining the well-known specialists of the country to prepare the instruction papers of the Institute but also—and perhaps this is the vital pivot upon which success swings—in the adoption of the principle of giving to each and every student such individual attention as if he were the only student on the instruction rolls. Every letter and every paper examined or answered by the instructors or the clerical force of the Institute has been read with a clear conception of the responsibilities involved and with a sympathetic understanding of the aspirations of the ambitious worker, who, while the remainder of the world seeks rest and recreation, devotes his spare hours to study.

This principle, namely, that successful education along such novel lines as these, depends to a great extent upon painstaking effort devoted to the simplest routine details, was recognized from the first and the successful accomplishment of the purpose is here again shown strikingly by the student himself, who is certainly best qualified to judge, for a most gratifying percentage of the great number of letters received close with the pregnant remark: "I thank you for the careful attention you have given my particular case."

Looking back over the first year of the Institute's work, we may point with pride, first, to the great number of ambitious workers who have been benefited by the teachings of the Institute; and secondly, to the great array of those whom we have served with our advice. We may truthfully state that many a man who has written to us with doubt in his mind as to the proper shaping of his career, has had his doubts removed by conscientious and sympathetic advice.

In every case, he has been told honestly and impartially of his chances of success. If he needed encouragement, this was given to him unstintedly; if his case demanded the warning, that the circumstances surrounding him were such, that a successful issue must be long delayed or was even doubtful, he was told so.

The work of the Institute, however, has during the past year been confined almost exclusively to teaching purely technical students of electrical engineering—members of that great class that go to make up the ranks of the profession and practical workers. While engaged in instructing such students, the Institute has been overwhelmed with requests from almost every State and Territory in the Union for a course of study which would be adapted to the needs of the great and growing intelligent but non-technical class of readers, who desire to acquaint themselves rapidly but without great effort with the interesting phenomena and marvelous applications of this fascinating science.

The main desideratum of a course of this kind was the elimination of all mathematical formulæ and the avoidance of lengthy introductory studies of general subjects. All these conditions have been squarely met in one of the new courses now offered by the Institute to the general public and the approbation which this "General Course A" is finding is evinced by the number of applications for enrollment received almost immediately upon the announcement of its completion.

The Institute is now enabled to offer to intending students over twenty different courses, all of which are clearly and fully set forth in the revised edition of that interesting little book entitled "Can I Become an Electrical Engineer," the enormous circulation of which we believe compares favorably with that of any book published during the past twelve months.

A second book of equal merit but designed on somewhat different lines and entitled "The Electrical Marvels of Our Times" has now also been added to the free list of the Institute so that both books are sent post-paid to any address upon request.

For copies of these books, prospective students are requested to address Department VI., The Electrical Engineer Institute, 120 Liberty street, New York, U. S. A.

Lehigh University.

The Register of Lehigh University, South Bethlehem, Pa., for the year 1898-99, shows few changes in the governing or teaching force. The department of mechanical engineering has lost the services of Messrs. B. H. Jones and L. O. Danse as instructors, and their places are filled by Messrs. L. N. Sullivan and J. C. Peck. Messrs. John Boyt and F. O. Dufour have been promoted from the grade of assistant to that of instructor, and Mr. Joseph Barrell has been elected instructor in geology and lithology.

Solid geometry has been added to the requirements for entrance to the Latin Scientific course and to that in Science and Letters; and it is announced that in 1900 and thereafter the requirements for entrance to the course in Science and Letters or to any course in the School of Technology will include plane trigonometry and logarithms through the solution of right and oblique triangles. The requirement in physics is retained but renewed emphasis is laid upon the importance of a thorough acquaintance with physical phenomena and with the simpler applications of physical laws.

The principle of elective studies is introduced into the technical courses. In the course of civil engineering, the student may elect a large amount of work in architecture in addition to the designing and structural work of the regular course and thus be fitted to take up on graduating the profession of an architect. In the courses of mechanical and electrical engineering a large proportion of the work is identical and students in either course may in addition elect a considerable amount of special work in the other course, under the advice of the Faculty, as a substitute for the same amount of work in his own course.

The Register includes a complete list of the University's graduates, showing clearly how wide an influence this thirty-three-year-old institution is exerting through its sons in all parts of our country and of the world. The total number of graduates is 1,028, of whom 981 are still living.

GERMANY is making a great increase in the strength and efficiency of its army telegraphs.

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STOCK MARKET

Trade Active, Stocks Dull.

The greatest activity in many lines of trade last week, with a corresponding demand for money, led to a lower range of prices generally on stocks, but such conditions can only be regarded in a favorable light. We are a little sorry even to see the demand for iron and steel so great, as it renders manufacturers rather indifferent to the big export trade that has lately been worked up. In cotton goods also there has been a marked advance, and the export trade in them is the largest known. The demand for all lines of electrical apparatus continues enormous, though the high price of copper is a cause for anxiety. For example, allowing 2,200 pounds of trolley wire per single track and 5,000 pounds for feed wire for each mile of track, the cost of overhead trolley construction on electric street railways has increased $450 since January 1.

During the week 7,542 shares of Western Union were sold, from 95⅜ down to 94½. Of General Electric 9,180 shares were sold, fluctuating from 115¼ to 112½. New York Edison on 1,848 shares closed at 197¼, and Metropolitan Street Railway on 42,771 shares closed at the high figure of 246. In Boston, American Bell Telephone maintained its high level at 369 and West End Railroad was firm at 93¼. An interesting feature in Philadelphia was the decline in Electric Storage Battery to 105 and a sharp rally to 120.

Copper during the week, Lake, was around 18 cents; Electrolytic, 17 to 17½.

LEGAL NOTES

The Siemens Pioneer Railway Litigation.

WHILE it appears that the suit upon the Siemens patent No. 324,176 has been discontinued in the Chicago court, there is no intention on the part of the Siemens & Halske Electric Company of America to relax or forego its claim under this patent, and it may be expected that there will be developments in the near future which will show that the exultation expressed by the General Electric side, as set forth in a recent review of the subject in these pages, was premature and was based upon erroneous grounds. It is considered sufficient answer to the statement that the Edison Menlo Park road contained the invention disclosed in the Siemens patent under consideration to refer to Mr. Edison's own description of this road as an experiment.

That there is no anticipation of the Siemens patent is alleged to be shown by the following statement, which appears in the work on "The Electric Railway," by Crosby and Bell: "During the summer of 1879 the first electric railway was put in operation, by the firm of Siemens & Halske, at the industrial exposition in Berlin. An oval track about 300 metres in circumference was laid down, and upon it ran a little electric locomotive dragging a single platform car. A third rail, placed midway between the others, served as the working conductor, and the current was taken from it by means of a sliding contact under the locomotive. The motor used was one of the regular Siemens dynamos, placed with its armature spindle parallel to the track; and the power was transmitted to the axle by a double gear reduction, including, of course, a pair of bevel gears. The outer rails served as a return for the current through the wheels of the locomotive. Eighteen or twenty passengers constituted the full load of the little train, and the time required for a complete circuit was from one to two minutes, corresponding to a speed of perhaps eight miles per hour.

"This road is notable as being the practical starting of modern electric traction. It is beyond all question the first working electric railroad on a practical scale. Up to that time nothing had been constructed which bore even the semblance of a commercial electric railway, and such few plans as had existed before, both in Europe and America, were mainly on paper."

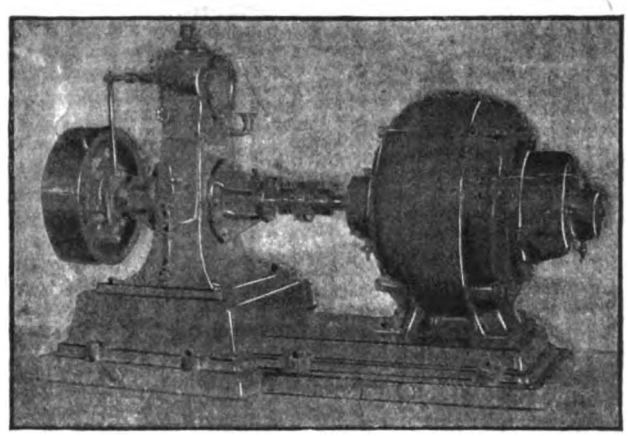
This based on the facts, is regarded as pretty strong and conclusive.

TRADE NOTES AND NOVELTIES

Armitage-Herschell Small Direct Connected Generating Set.

THE accompanying cut shows the line of small generators direct connected to Case engines, now being placed upon the market by the Armitage-Herschell Co., of North Tonawanda, N. Y. They are designed to meet the demand for compact and self-contained sets of small capacity. The engine is of the well known high-speed type built by the Case Engine Company, while the generators are of a special slow speed type, but having the general points of merit of this company's enclosed M. P. apparatus.

Among the cardinal points are the one-piece cast-steel field



ARMITAGE-HERSCHELL SMALL DIRECT CONNECTED GENERATING SET.

rings, ample self-oiling bearings, ventilated form-wound armatures, carbon brushes with low current density, and the ability to carry from no load to 50 per cent. overload, with sparkless commutation.

This type is built in the following sizes: 25 light, 40 light, 80 light, 125 light, 200 light and 300 light; the heating limit for 10 hours at full load, being 47 degrees centigrade above the surrounding air. The brush holders are of a new radial "Hammer" type, and give the brushes an even firm contact upon the commutator and a rigid contact against the holder. The above company will be glad to furnish any additional information desired, and solicits correspondence.

Barton & Brown.

The well-known patent law firm of Barton & Brown, of Chicago, has been dissolved by mutual consent, the partners dividing the offices hitherto used in common, and both continuing in the practice of their profession. Mr. Charles A. Brown has, however, associated with himself Mr. George L. Cragg, who was with the old firm since its organization, and who came into its service with a thorough technical and scientific training. The firm name will be Charles A. Brown & Cragg, and their suite of offices will be under the number 1450 Monadnock Block, Chicago.

Large Telephone Switchboards.

The large switchboard of the Kinloch Telephone Company, of St. Louis, which was installed the latter part of last year with a present actual capacity of 6,160 lines, is now in successful operation with about 4,500 subscribers' lines actually in use, while new lines are being added constantly. It is stated that the present orders of the Kinloch Company aggregate between five and six thousand subscribers. The company has already under construction additional switchboard sections which will be completed this season, and will bring the actual capacity of the board to 8,800

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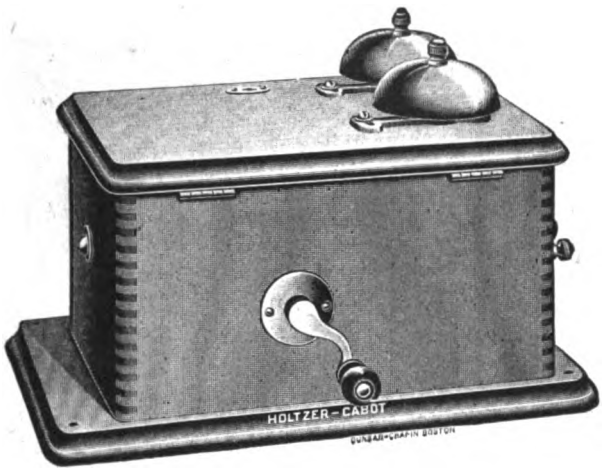
lines. The ultimate capacity of the board will be 20,000 lines in one exchange building. With this number of lines all the connections will be completed with no more than one operator for each connection. The Kinloch switchboard is said to be the largest in the world, in which each connection is completed by one operator. A similar switchboard is being constructed for the Cuyahoga Telephone Company, of Cleveland, Ohio, with a present capacity for 5,760 lines and an ultimate capacity for 20,000 lines. These companies are independent companies.

These switchboards are on the Kellogg "Divided Exchange Multiple Switchboard System," the general principles of which were described in our columns several years ago when we pointed out its advantages in the operation of large exchanges.

Holtzer-Cabot Electric Co., Improved Magnet Bells

IN equipping a telephone line or exchange, it is very important to procure telephone instruments provided with reliable magneto bells. The market is filled with all sorts of bells claimed to work perfectly on local as well as long-distance lines while



HOLTZER-CABOT MAGNETO BELL.

few of them even merit the attention of purchasers of telephone apparatus.

The Holtzer-Cabot Electric Company, Boston (Brookline), Mass., whose magneto bell we illustrate herewith have had many years' experience in the manufacture of this class of apparatus, and spare neither pains nor cost to turn out a superior line of these goods.

In the construction of the generator, it will be observed that they have made a departure from the ordinary method of securing the permanent magnets to the fields, which is usually done by bolting through from one side to the other. If these bolts are tightened up sufficiently to keep the magnets in place during transit, they are very liable to spring the fields, thus causing the armatures to bind. The manner in which they have overcome this difficulty is clearly shown in the figure. The magnets are held on by means of short bolts, which enter into projections in the field pieces. They can, therefore, be firmly secured without any danger of springing the fields. This construction admits of the generator being taken from the box without removing the hook, or even taking the magneto from the wall.

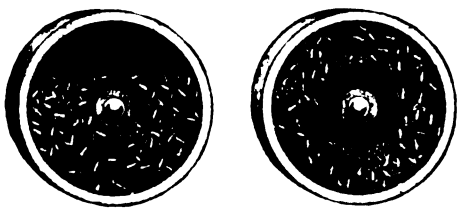
The generators are equipped with gears or chain and sprocket, as desired. The latter method of driving is very popular. The connections between the driving wheel and pinion are made adjustable, and a special hard steel chain is used which is guaranteed not to stretch or wear. The gears are finely cut, have an extra wide face, and are practically noiseless in operation. The flexible method by which they attach the pinion to the shaft, shown in the accompanying cut, assures a steady and uniform movement of the armature while passing through the varying magnetic field.

The armature is constructed of the best soft laminated iron, assembled on steel shafts, accurately fitted and thoroughly insulated. Nearly twice the output is secured by this method of construction over the old design, in which cast-iron is used.

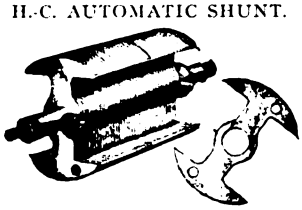
As the shunt depends for its operation on natural forces only, there are no springs to get out of order. It is reliable under all conditions. The slightest movement of the armature opens the circuit immediately, yet a circuit of practically no resistance is positively established whenever the armature comes to rest. The granules are silver plated, which insures always a reliable contact. The case is hermetically sealed, which effectually prevents any oil or dirt reaching the contacts. The figure shows the shunt open and closed.

The method of supporting the armature of the striker and at the same time holding the few parts rigidly in proper relation to one another, the facility by which such adjustment can be accurately made, simply by turning one screw, which raises or lowers the yoke carrying the armature, will commend this striker to telephone men generally. It will be observed that the armature is always maintained centrally over the pole pieces, and in the best possible relation to them and to the permanent magnetic field.

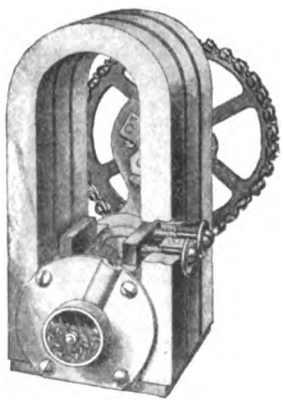
Further information about this magneto bell and other telephone apparatus are contained in catalogue No. 35 recently issued by the company.



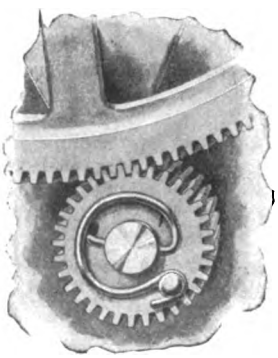
H.-C. AUTOMATIC SHUNT.



ARMATURE CORE.



MAGNETO GENERATOR.



FLEXIBLE METHOD OF GEARING.

STRIKER.

Eureka Telephone Apparatus.

The Eureka Electric Company, of Chicago, have met with quite a success upon their telephone apparatus, as they are placing upon the market a strictly high grade line of telephones. The trade in general is recognizing the merits of their instruments, and in consequence the company are securing very nice contracts daily. The principal features of their telephones are their amplifying, long distance transmitter, which is guaranteed to ring indefinitely, and for articulation and quality of tone.

The magnetos used upon their instruments are of the well known Eureka type, full nickeled and very powerful. The receivers are double pole and the work is of the highest finish. They meet every requirement that may be exacted of them and the constant duplicate orders the company are receiving, show that their instruments are giving general satisfaction. Their new No. 44 transmitter is adapted for replacing upon instruments, either upon the magneto or upon the transmitter boxes, and is guaranteed to give entire satisfaction.

The company will cheerfully furnish additional information as

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to their magnetos, transmitters, receivers, and other parts as well as switchboards, cable boxes, cross-connecting boards, and other apparatus used in the construction of high grade telephone plants. They are located at 157-159 South Canal street. They have beautiful salesrooms and have all facilities for handling telephone business.

Uses of Micanite.

Electrical engineers who are not already familiar as to the value of "Micanite" as an insulator for commutator segments and rings, will do well to write the Mica Insulator Company, of New York and Chicago, regarding same. They make a specialty of furnishing segments for any style or type of machine, and have manufactured some segments recently as long as 30½ inches and 4 inches in height. The company report a very heavy business, both in this country and in Europe.

Builders of electrical apparatus will do well to have before them the company's sheet insulation manual and data book. It not only gives the breakdown tests of their insulations, but contains samples of the goods they manufacture. A large stock of "Micanite" plates, cloth, tubes, paper and "Empire" and "M. I. C. Compound" insulations is carried at New York and Chicago; also at their sales agencies in Cincinnati, St. Louis, San Francisco and Cleveland.

Western Electrical Supply Co.

The Western Electrical Supply Company, of St. Louis Mo., through their Engineering Department, report the outlook for a large spring business most encouraging. The numerous Warren alternating current machines which they have sold during the past season are more than pleasing their customers, and henceforth they expect a rapid increase in their business in this line. They are now busy working on several large contracts for Warren alternating equipment. They believe that prospective purchasers of electrical machinery consult their best interests by communicating with them before purchasing elsewhere.

Ball Engine Co.

The United States Naval Station at Bremerton, Wash., is installing a direct-connected combination, consisting of two 50 k. w. General Electric generators and a tandem compound condensing engine built by the Ball Engine Company, Erie, Pa.

The Toledo Glass Company, Toledo, Ohio, have recently installed two direct-connected combinations, consisting of 65 k. w. generators direct-connected to engines built by the Ball Engine Company.

The Armour elevators of Chicago have recently added to their electric plant a 30 k. w. General Electric generator direct-connected to an engine built by the Ball Engine Company.

New York Electric Vehicle Transportation Co.

Announcement is made of the formation of the New York Electric Vehicle Transportation Company, articles of incorporation of which were filed in Trenton, N. J., last week. It has a capital stock of $25,000,000.

The company is empowered to acquire and manufacture and buy and sell vehicles of all kinds to be operated by electricity, compressed air, gas, oil and other means of motive power; also to acquire franchises for the operating of these vehicles to carry passengers and freight of all descriptions. The incorporators are James E. Hayes, Camden; Edwin Gratz, 18 William street, New York, and Augustus Treadwell, 20 Broad street, New York.

It is understood that the charter of the new company permits it to operate its vehicles not only in this city, but in all parts of the State.

Mr. Isaac L. Rice, the president of the Electric Vehicle Company, a concern formed some time ago, with a capital stock of $10,000,000, yesterday said that the new company meant nothing more than an enlargement of the present concern. Harmonious relations with Metropolitan Street Railway interests are broadly hinted at.

THE GARTON-DANIELS ELECTRIC CO., of Keokuk, Ia., have just appointed Messrs. Mayer & Englund, of 10 S. 10th street, Philadelphia, Pa., their representatives in the Middle States territory, for their line of railway lightning arresters.

Penna. Electric Vehicle Co.

A new company, known as the Pennsylvania Electric Vehicle Co. has just been brought out. It has the rights to the patents of the Electric Vehicle Co., and under license from the parent company can operate a cab service or organize cab companies in Philadelphia and elsewhere in Pennsylvania. Mr. W. W. Gibbs will be president of the Pennsylvania Co., and other interests who have been identified with the Electric Storage Battery Co. and the Electric Vehicle Co., it is understood, will be in the management. The Pennsylvania Co. has an authorized capital of $2,000,000, cumulative preferred stock, and $4,000,000 common, par value $50 per share. The 20,000 shares of preferred have been offered privately for subscription, and were largely over subscribed, as shares of common went as bonus with the preferred, which was sold at par for cash. The stock represents the patent rights and operating license, secured from the Electric Vehicle Co. and others. Philadelphia will soon have a large number of electric cabs, supplied by this company.

The Harrison Primary Cell No. 1.

The No. 1 Harrison cell described in a recent issue, is practically a new departure in primary cells, for, while peroxide of lead has long been used in connection with storage batteries, it has never before been successfully used in a primary cell. The other materials used in the Harrison cell have only been adopted after years of experiment. The mechanical construction of the cell is as near perfection as intelligent effort can make it, and every point has been carefully worked out with two ends in view, viz., simplicity and stability.

The combination is a primary cell of lead peroxide and zinc amalgam with dilute sulphuric acid as the electrolyte which gives the highest e. m. f. (2.45 volts) obtainable in a practical primary cell. The quick depolarization obtained by the use of specially prepared lead peroxide together with the low resistance of the electrolyte and its high voltage makes the Harrison cell probably the most powerful open circuit cell thus far devised. Its recuperative powers are phenomenal and the amount of work it will do is extraordinary when its size is taken into consideration. The small size of the cell—it is only 5 inches high by 3 inches square—is one of its special features. Where space is a consideration the Harrison cell is most suitable, as it occupies only a fraction of the space usually required.

Its high voltage reduces by nearly one-half the number of cells required for a given purpose when compared with the usual type of cell. Its cleanliness in operation, the absence of creeping salts and corroded connections, its freedom from freezing in cold weather and liability to destruction by short circuiting, combined with the cheapness of its maintenance and renewals, are among its characteristic features.

It is estimated that the cost of the electrical energy obtained from this cell is about 1 per cent. per watt hour. The battery will give on ordinary circuit work a discharge of 40 ampere hours or over 80 watt hours.

The cell is adapted for all kinds of open circuit work and will keep its charge indefinitely when standing idle, as there is no local action on open circuit to cause deterioration. When the cell shows signs of weakness, the liquid is thrown away and the cell re-charged. When it again grows weak, the negative element or lead peroxide stick is replaced with a new one. This is easily done by unscrewing the binding post and removing the exhausted stick and inserting a new one. The positive or zinc element will generally outlast two peroxide sticks and when used up can be renewed in the same way. The cell is made by Harrison Bros. & Co., Incorporated, Philadelphia. The Thermo Electric Co., Times Building, New York, are the sole agents.

Fort Wayne Electric Corporation.

A special despatch from Fort Wayne of February 16 says: Three weeks ago creditors of the Fort Wayne Electric Company petitioned to throw the concern into bankruptcy. The corporation attorneys asked United States Judge Baker to grant ten days' time to file an answer and contest the case. To-day President Worden notified the court that there would be no contest, and the corporation will go voluntarily into bankruptcy on the petition of its creditors, possibly on Saturday.

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ADVERTISERS' HINTS

THE CUTLER-HAMMER MFG. CO., Chicago, Ill., say the C. & H. rheostats are recognized standards.

THE BIBBER-WHITE CO., 49 Federal street, Boston, illustrate their street fixture No. 3. These incandescent fixtures are furnished complete with 4-foot goose neck of ¾ pipe, standard 16-inch hood and 14½-inch deflector of heavy tin. All castings are of malleable iron, including a yoke of this metal on which insulators of the glass type are used. Their prices may be obtained by dropping them a card.

McINTOSH, SEYMOUR & CO., Auburn, N. Y., are going to illustrate their "ads" hereafter with engravings of their different recent installations. They make all sizes and types of engines and special engines to meet any requirements.

GEO. W. HOFFMAN, 295 E. Washington street, Indianapolis, Ind., says in order to be up to date, United States metal polish must be used.

THE AMERICAN ELECTRICAL HEATER CO., 197 River street, Detroit, Mich., advertise their electric heating discs as valuable for the sick room or nursery.

F. A. LA ROCHE & CO., 13th and Hudson streets, New York, are offering circuit breakers in a variety of styles and types.

THE HART & HEGEMAN MFG. CO., state that all Hart switches have the words "Hart Switch" stamped in the metal and advise switch buyers to make sure that this stamp is on switches received, as other switches are sometimes substituted when Hart switches are specified.

WESTERN NOTES

THE ELECTRICAL APPLIANCE CO. are now thoroughly established in their new quarters, and a tour of their new building shows superior facilities for successfully handling a very large electrical supply business.

THE KURTZ NATIONAL TELEPHONE CO. has been incorporated at Belleville, Ill., for $20,000, with an allowed increase to $180,000, for future business as a parent company. The company is named after its president and electrical engineer, W. J. Kurtz, the concern using his new improved telephone and power system; Hon. W. De Bolt, of St. Louis, is secretary and treasurer: Victor H. Adami, electrical engineer, with the L. M. Rumsey Mfg. Co., vice-president. The above officers, together with L. M. Rumsey and Joseph M. Duffy, constitute the directory. Over 200 five-year contracts have been secured here for a model plant, with St. Louis connection.

NEW YORK NOTES.

THE GOLD ELECTRIC HEATERS were, it is claimed, the only ones that were effective on the cars during the recent cold weather. The Gold Street Car Heating Company, which manufactures these heaters, points with pride to the number of commendatory notices which were printed by the Chicago papers saying that the cars on the South Side Elevated Road were the only cars in which the heat was felt, and further that these cars were comfortably heated all during the severe cold weather to which Chicago was subjected during the past ten days. The Gold standard electric heaters were used in these cars and at no time were they used to more than half their capacity, showing that they could have endured conditions twice as severe as they did and still give the greatest satisfaction.

WILBUR B. DRIVER & CO., 126 Liberty street, New York, make a specialty of resistance wires for all kinds of work. For high resistance, "Climax" has forty-five times the resistance of copper (almost three times 18% German silver), and a temperature coefficient of .00042 per degree Fahr. For measuring instruments and work requiring constant resistance at all temperatures they have a material thirty times copper, and negligible temperature coefficient. Still another wire, with about the same resistance as German silver, has half the temperature coefficient of it, and is much better mechanically. These wires cover quite fully the demands for resistance material.

NIAGARA FALLS, N. Y. The Niagara Falls & Lewiston Electric Railroad, better known as the Gorge Road of Niagara, has changed hands, Capt. John M. Brinker and R. W. Jones having parted with their controlling interest in the company, but both remain large stockholders. The interest they sold was represented by bonds. The purchasers are stated to be New York parties, no names being mentioned as yet. Joseph R. Megrue, of New York, formerly manager of the Detroit & Lima Northern Line, has been appointed manager, and has taken charge of the affairs of the road.

MR. FRANK SHEPARD is now associated as salesman with the New York office of C. S. Knowles & Co., 120 Broadway, manufacturers and dealers in hard rubber goods, turned mold work and other electrical specialties.

EUGENE MUNSELL & CO., of New York and Chicago, report a very gratifying demand for their India and Amber "Mica," of which they make a specialty for electrical insulation. Some very large orders have been received at both their Chicago and New York addresses.

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Department News Items will be found in advertising pages.

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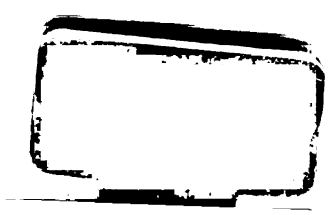

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